STS-1 NOMINAL

CYCLE 3 MARCH/APRIL LAUNCH

ASCENT BASE CONVECTIVE HEATING ENVIRONMENTS

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Final Report
For
Contract NAS8-33725

For

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

REMTECH inc.

SUMMARY

Ascent base convective heating environments have been determined for the nominal ascent trajectory for the STS-1 Cycle 3 March/April launch period, Reference 1. Both first and second stage environments are defined for all base heating DFI locations and design body points of interest. An identical format to the STS-1 dispersed trajectory environment, Reference 2, was followed throughout.

As expected, STS-1 nominal environments are generally less severe than those determined for the high loft and low loft dispersed trajectory conditions. The reduction in cold wall heating with the nominal trajectory varies for each base location analyzed, but, in general, was approximately twenty (20) percent.

REFERENCES

1. R. I. Internal Letter SAS/MR&I-79-724, "STS-1 Cycle 3 March/April Launch Ascent Trajectories (EMS Milestone 790-700-207)," dated February 14, 1980.

2. MSFC Memo ED33-80-10, "Design Assessment STS-1 Base Heating Environment (March 30, 1980 Launch Trajectory)," dated March 12, 1980.

STS-1 NOMINAL

FIRST STAGE CONVECTIVE BASE HEATING ENVIRONMENT

TO DFI LOCATIONS AND SELECTED DESIGN BODY POINTS

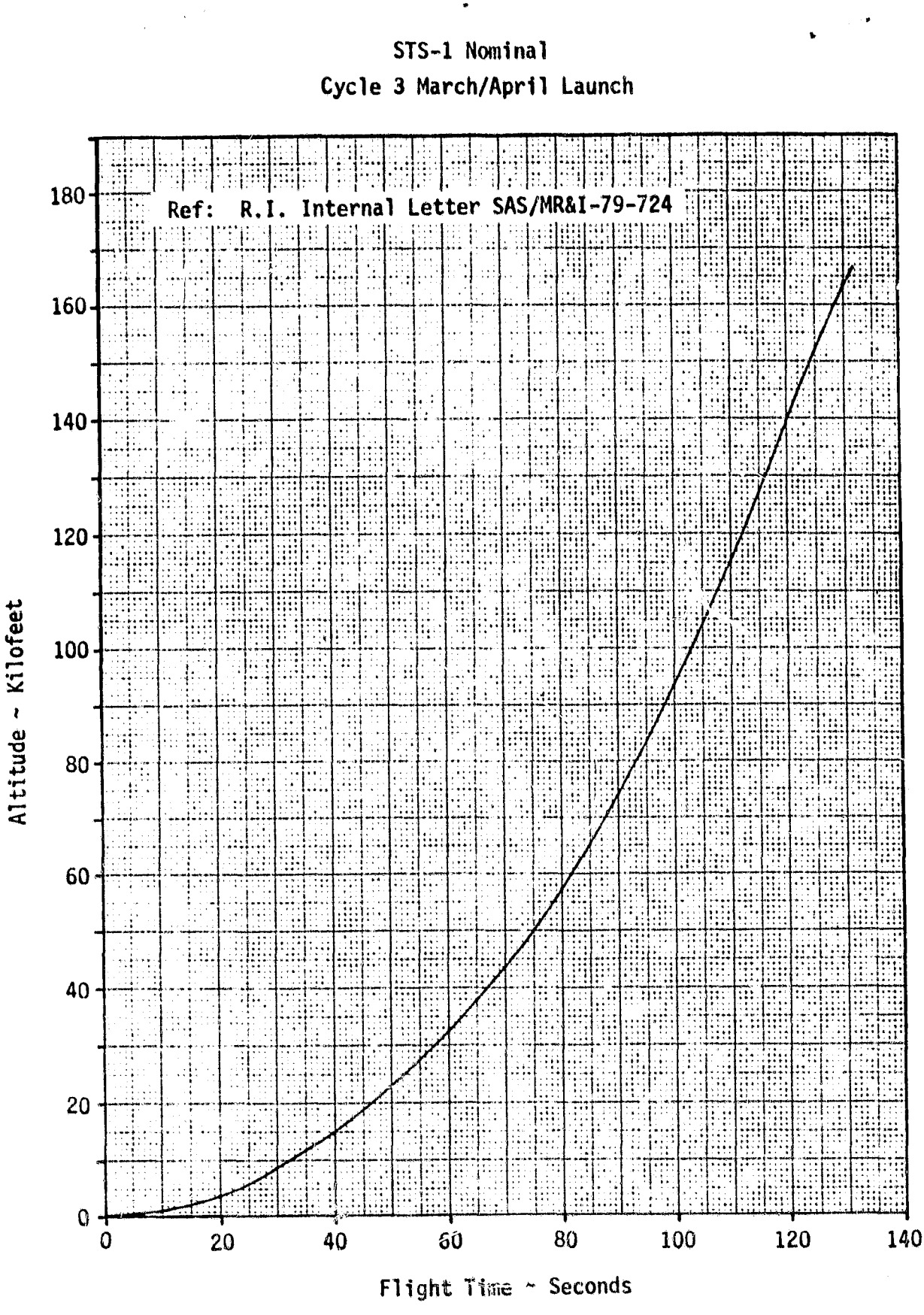

Figure 1. STS-1 Nominal Trajectory - Cycle 3 March/April Launch

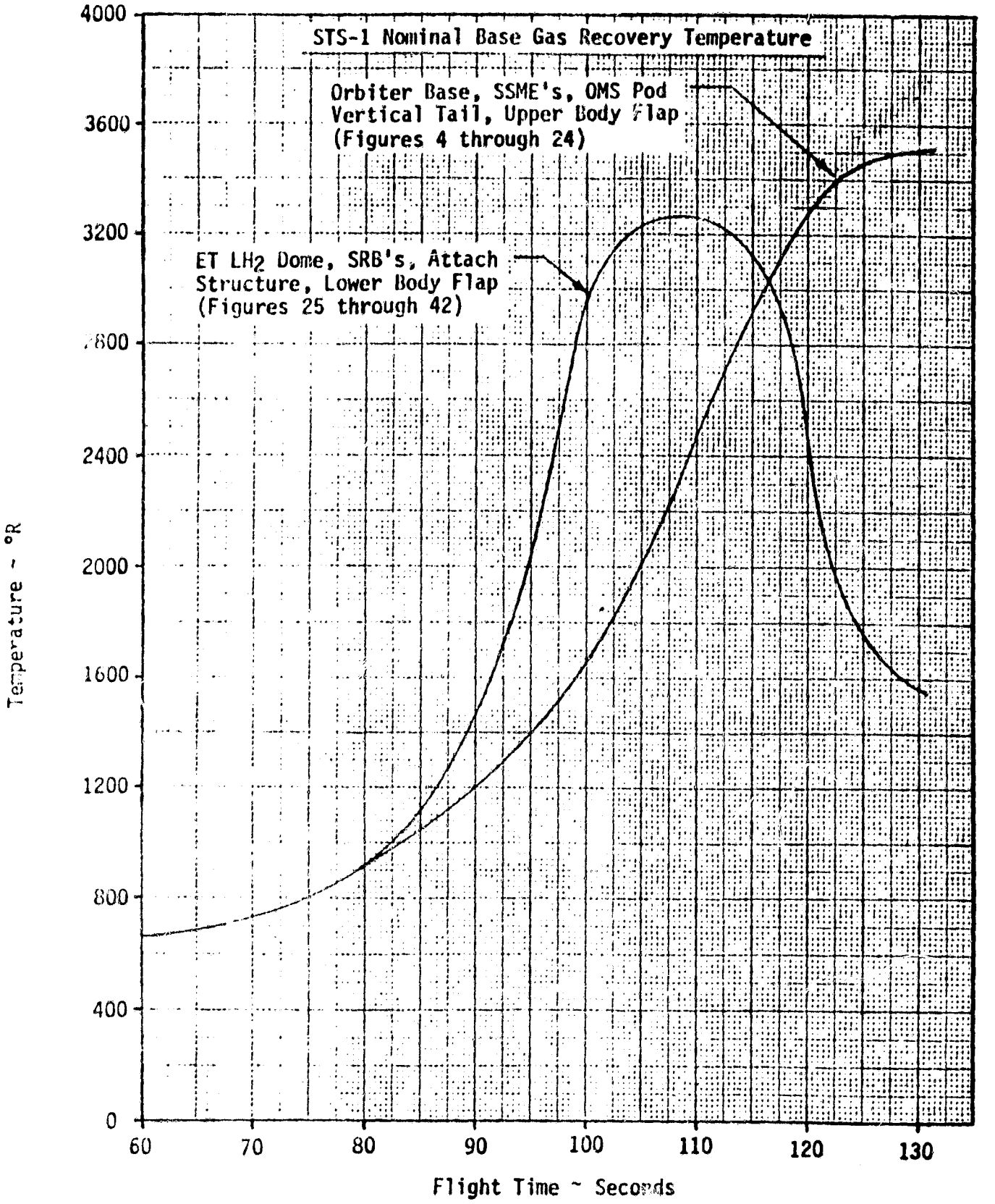

Figure 2. STS-1 Nominal First Stage Base Gas REcovery Temperature

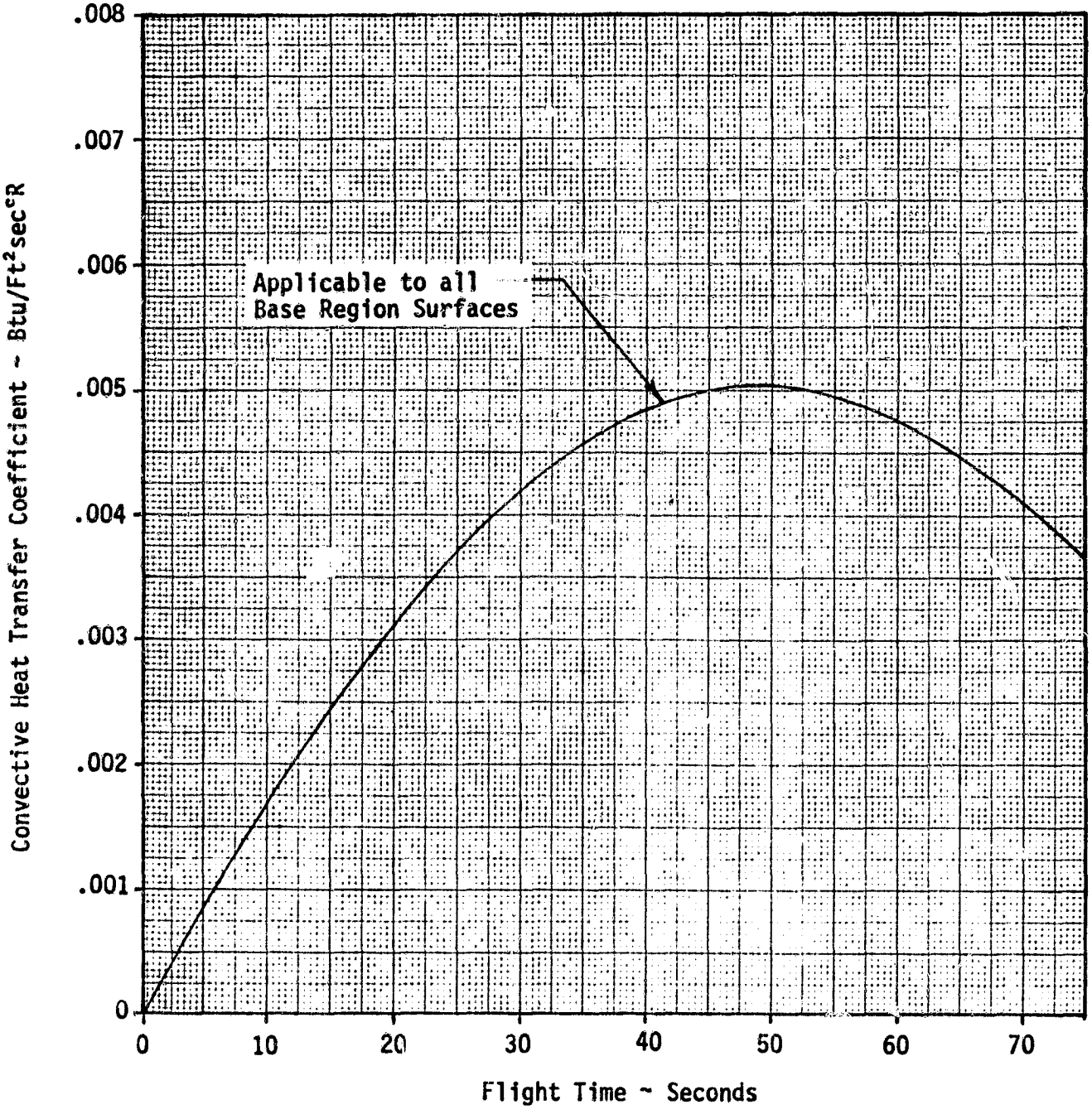

Figure 3. STS-1 Nominal First Stage Convective Base Heating Environment - Prior to Recirculation

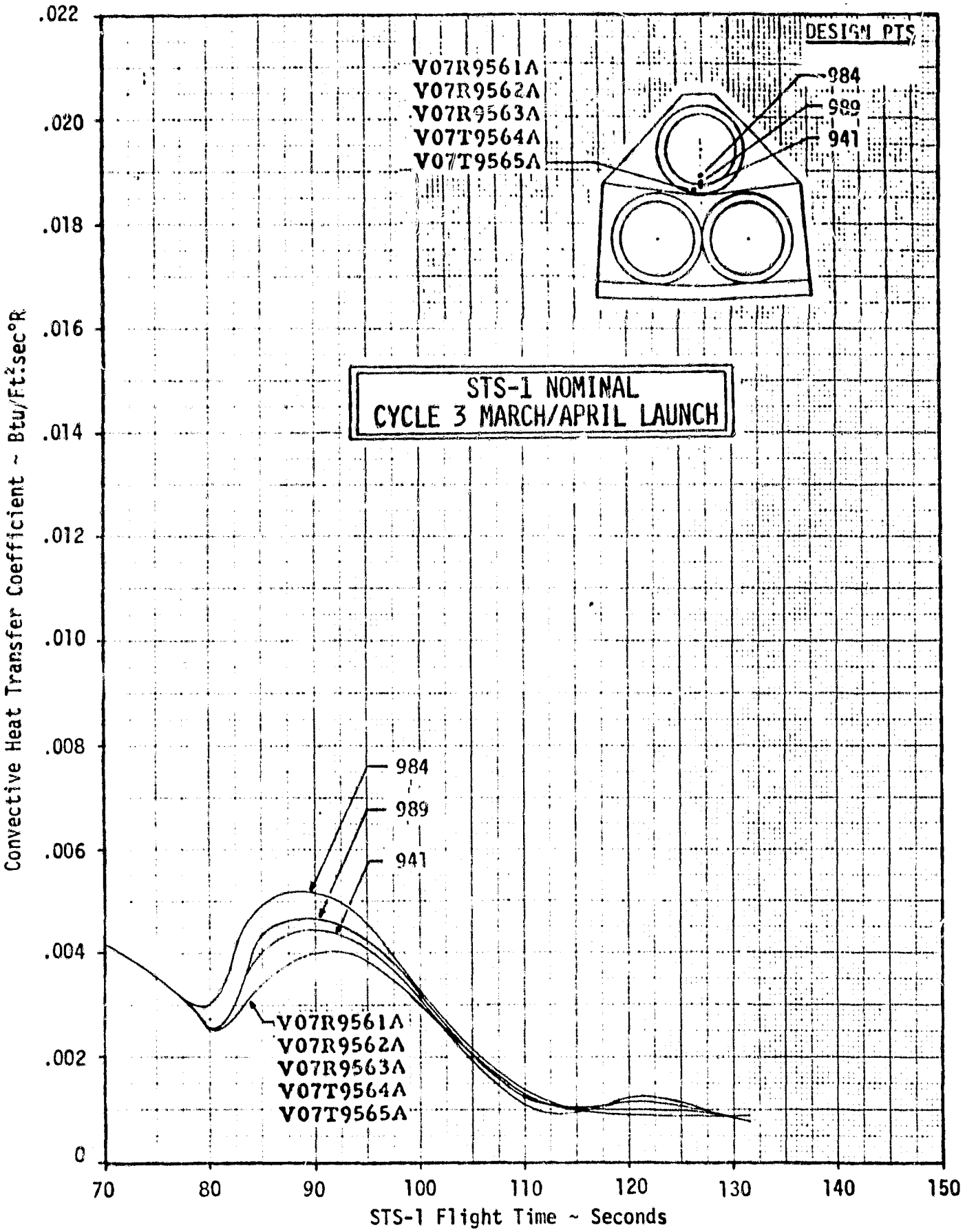

Figure 4. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

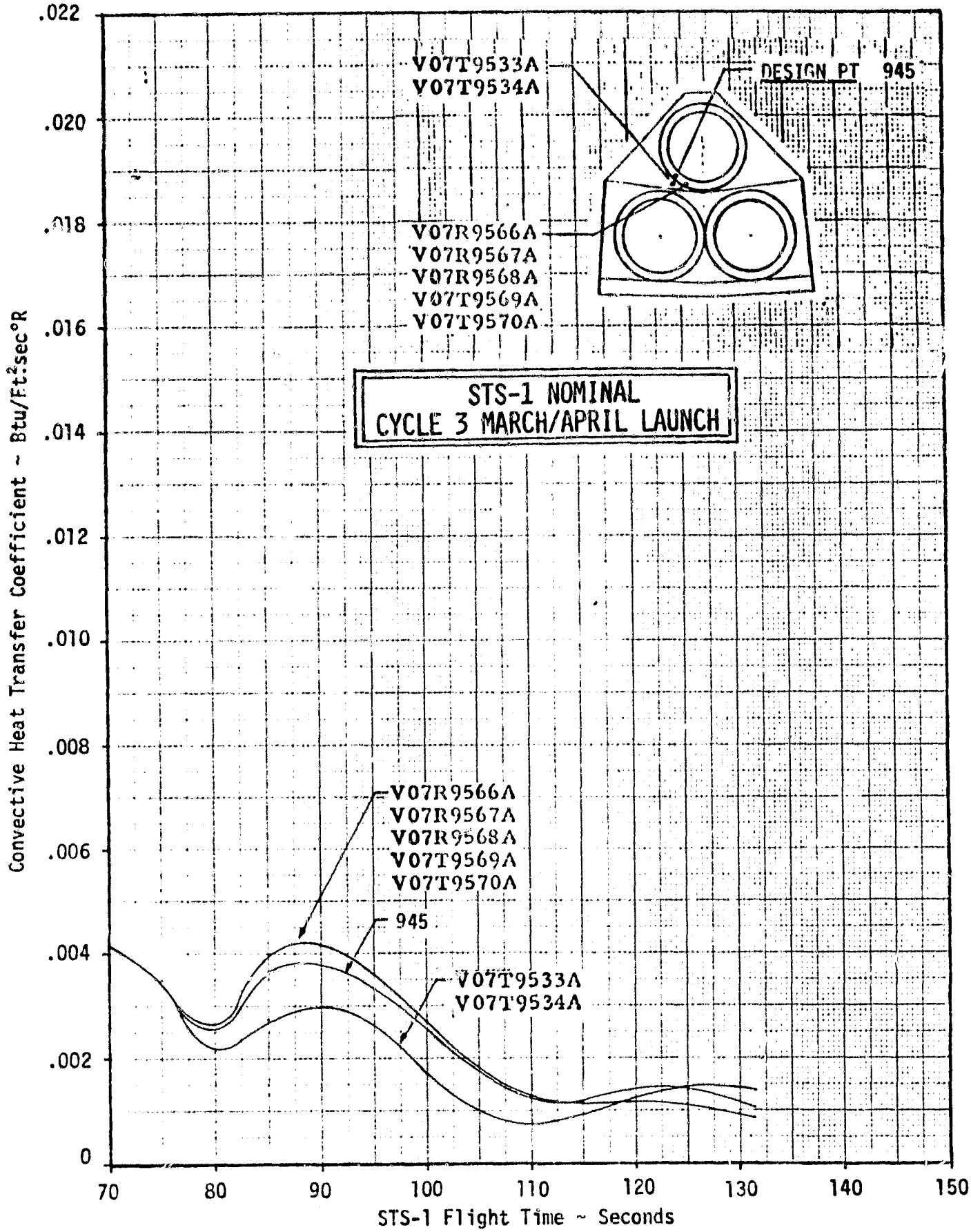

Figure 5. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

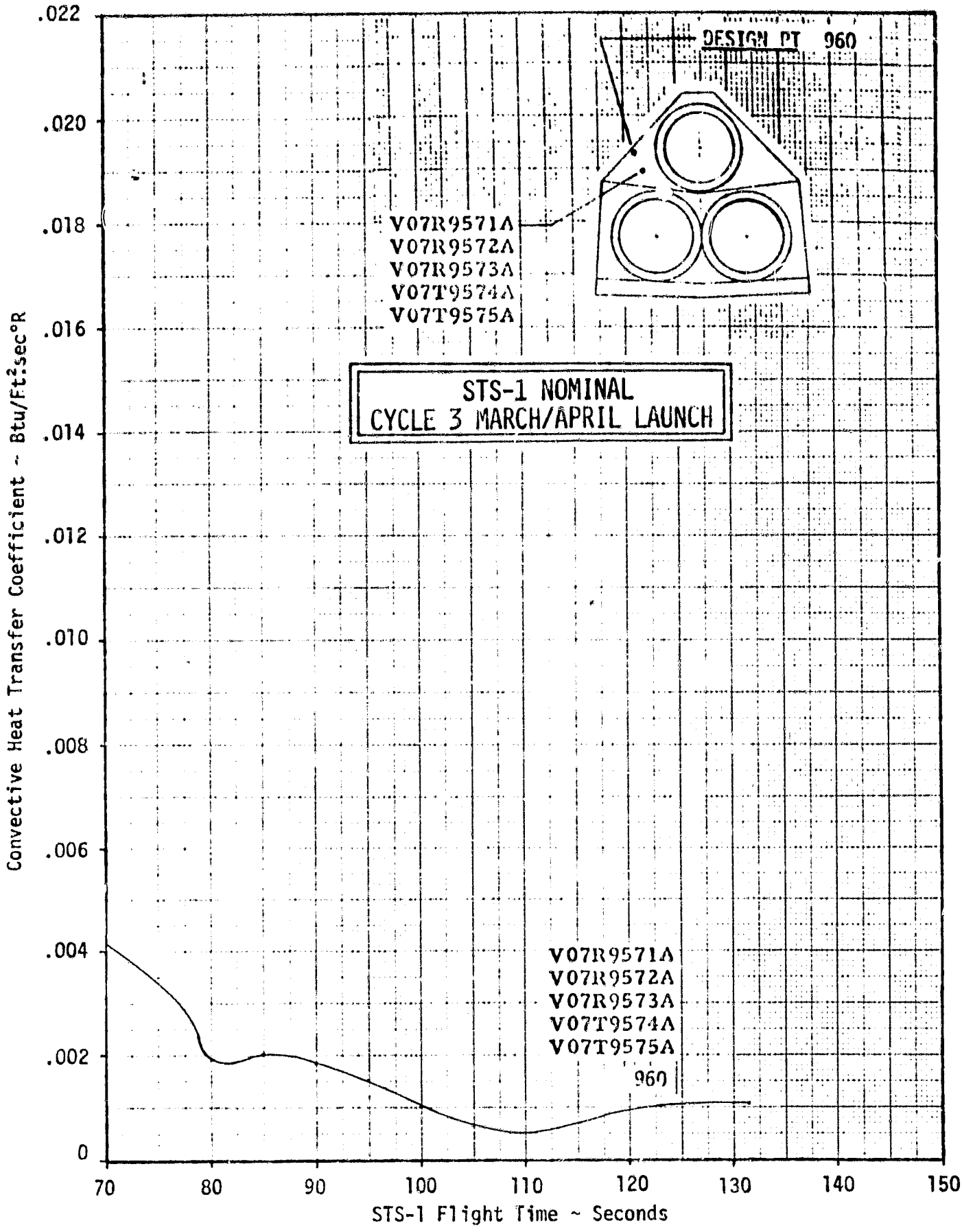

Figure 6. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

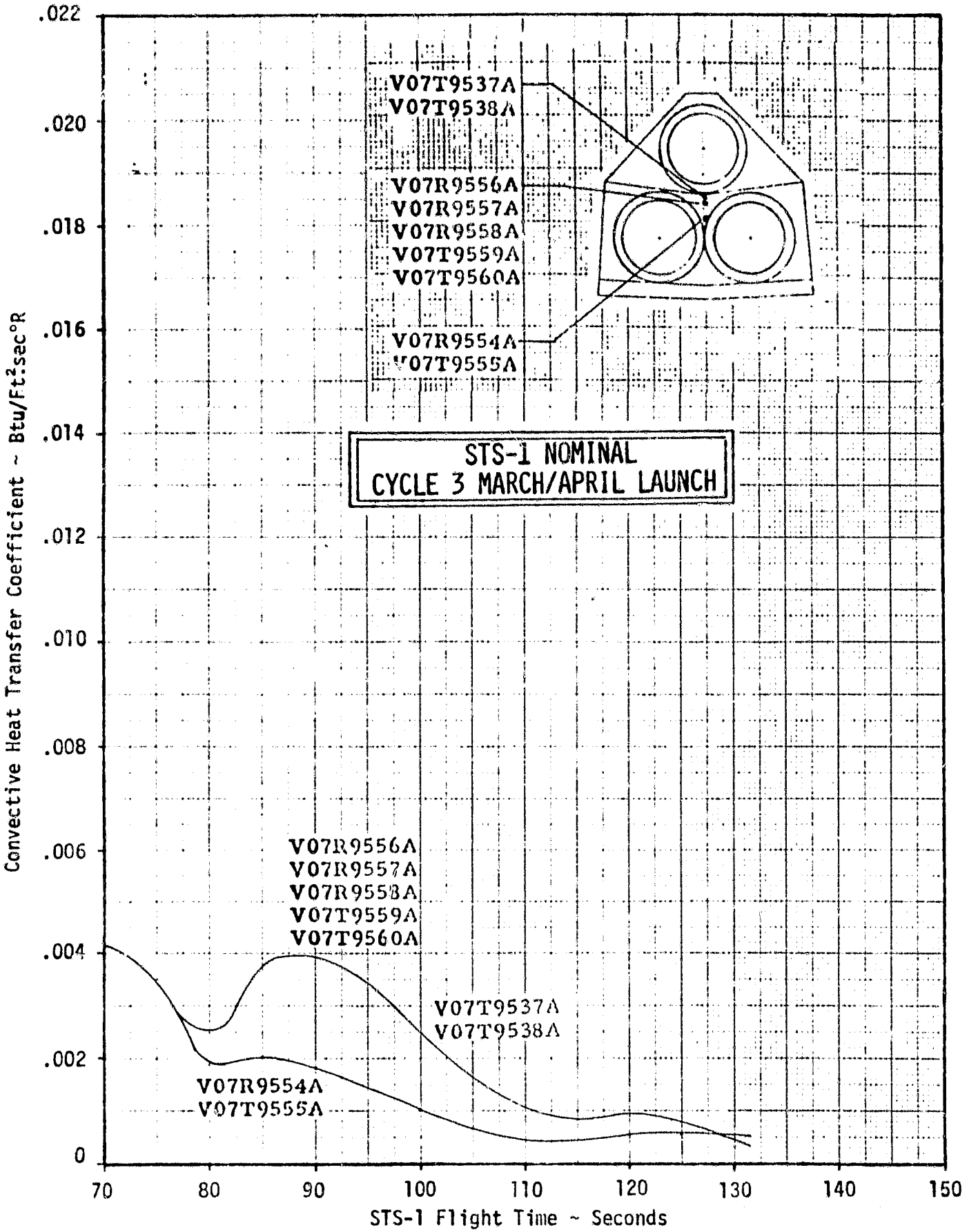

Figure 7. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

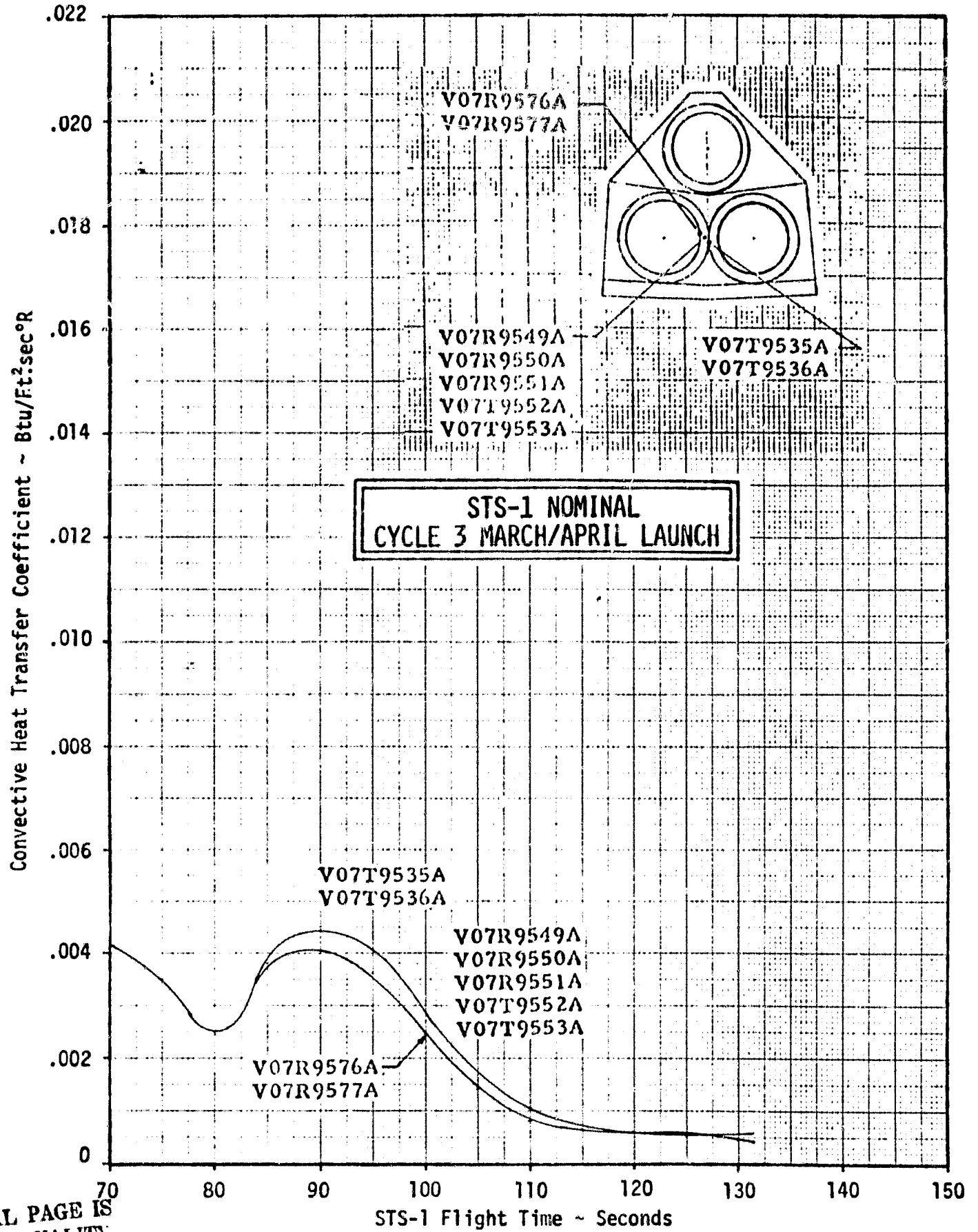

Figure 8. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

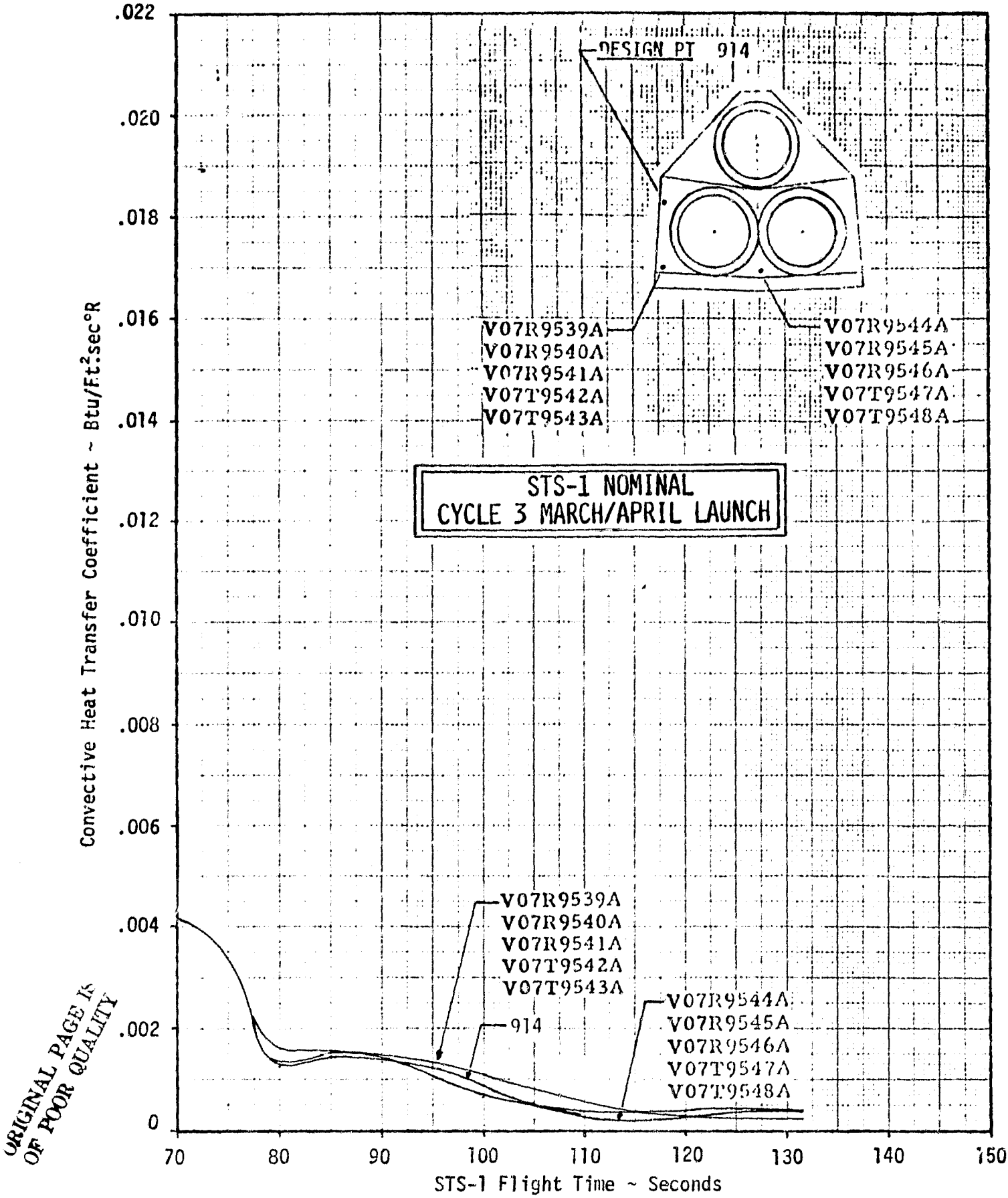

Figure 9. STS-1 First Stage Convective Base Heating Environment - Orbiter Heat Shield

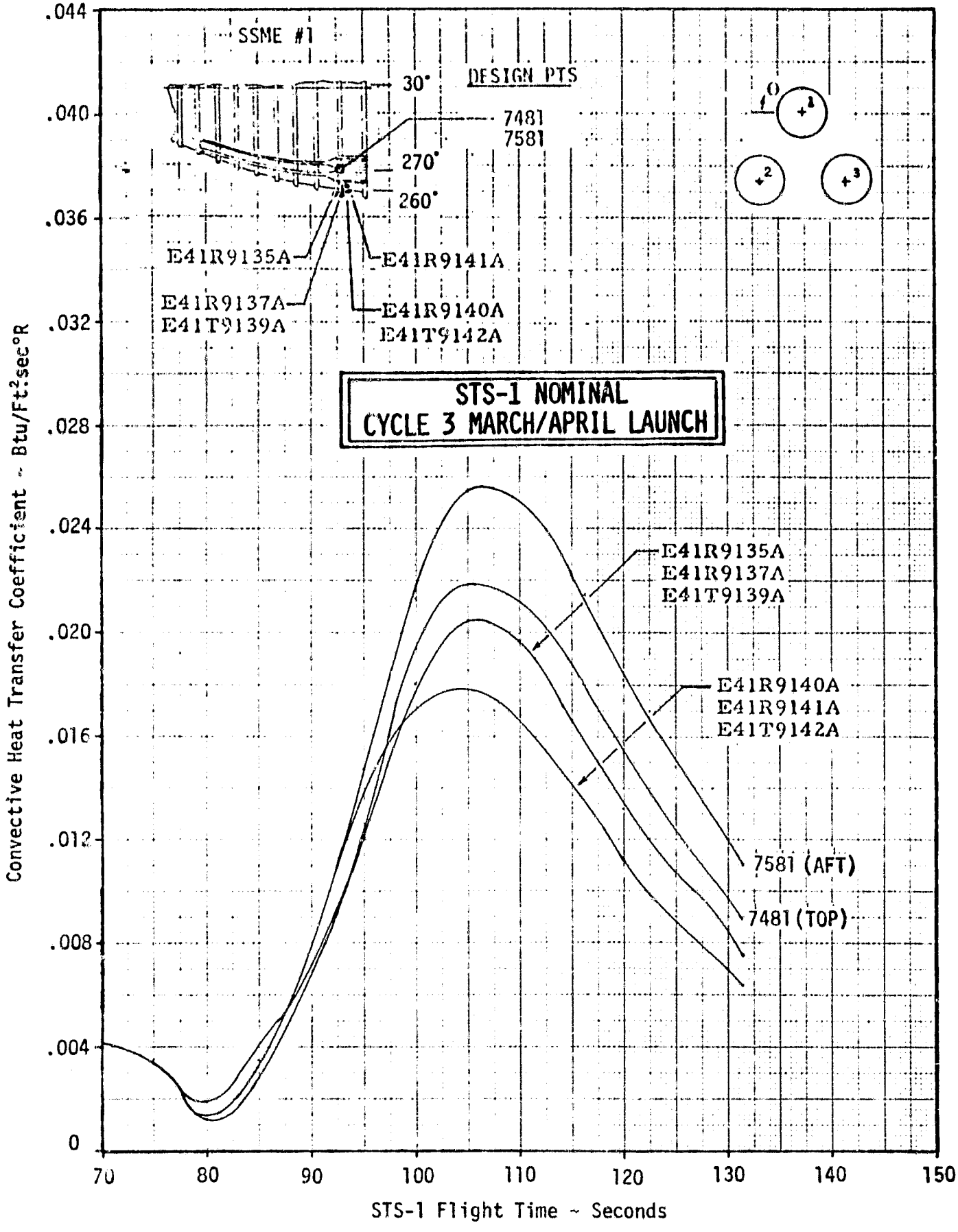

Figure 10. STS-1 First Stage Convective Base Heating Environment - SSME #1

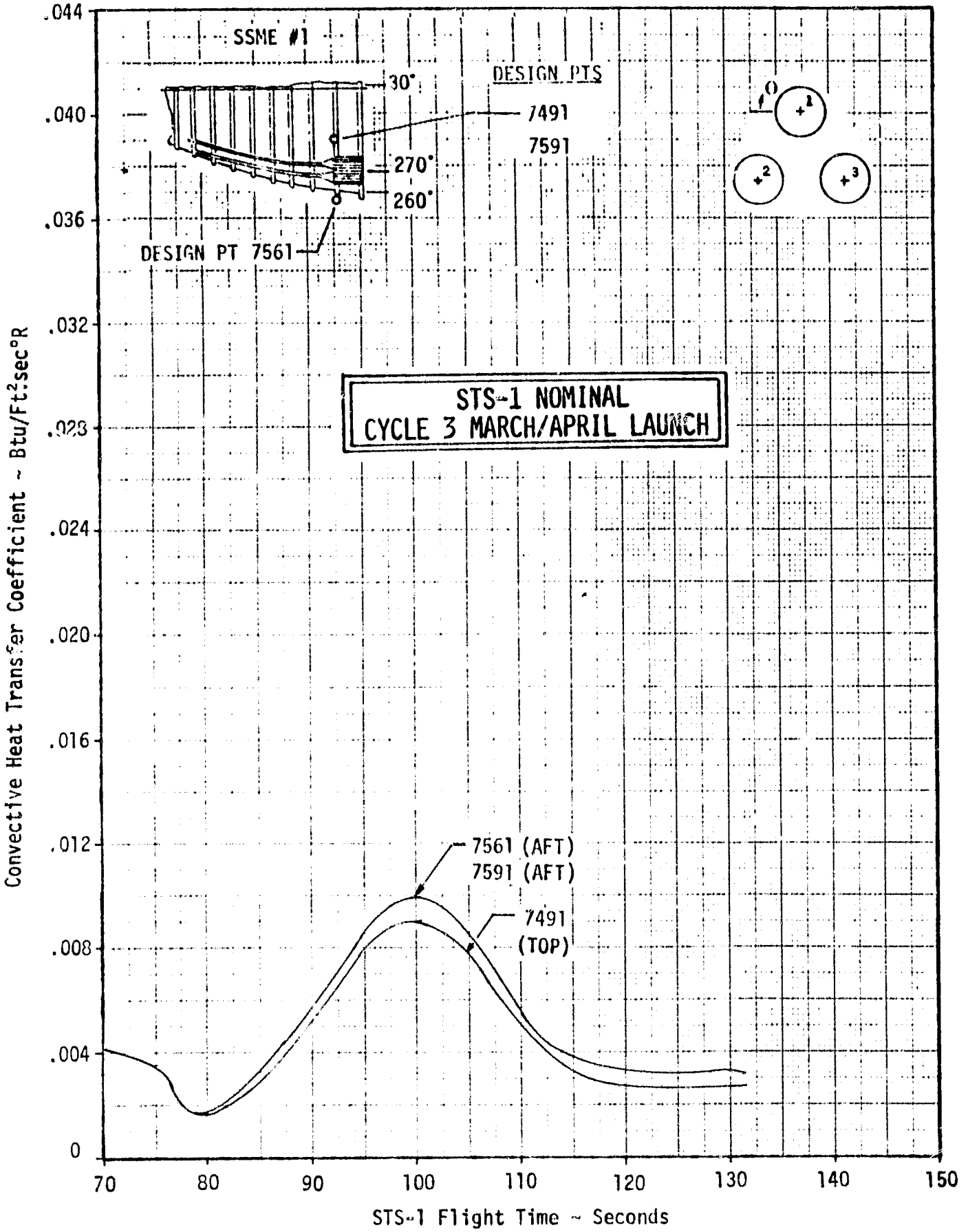

Figure 11. STS-1 First Stage Convective Base Heating Environment - SSME #1

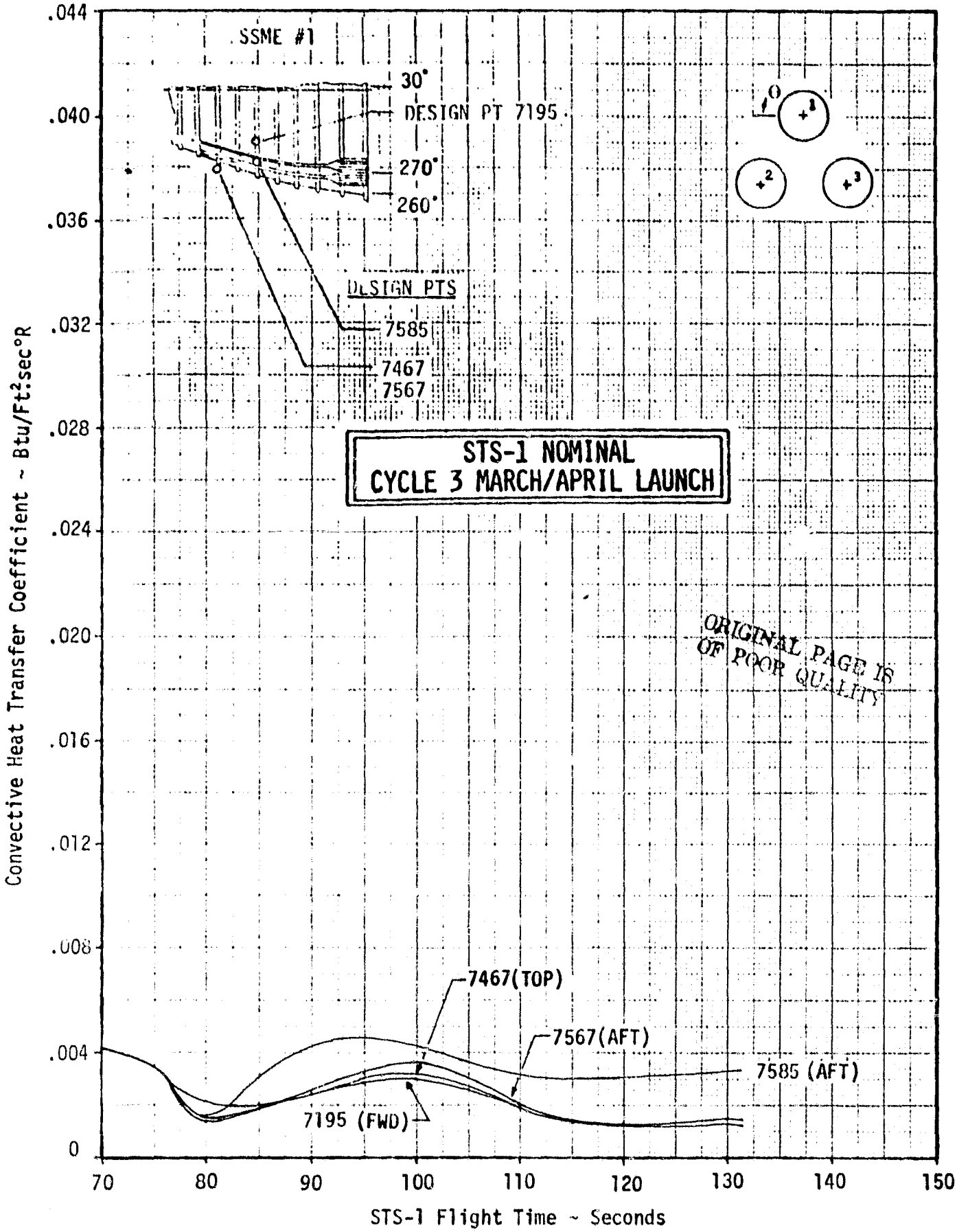

Figure 12. STS-1 First Stage Convective Base Heating Environment - SSME #1

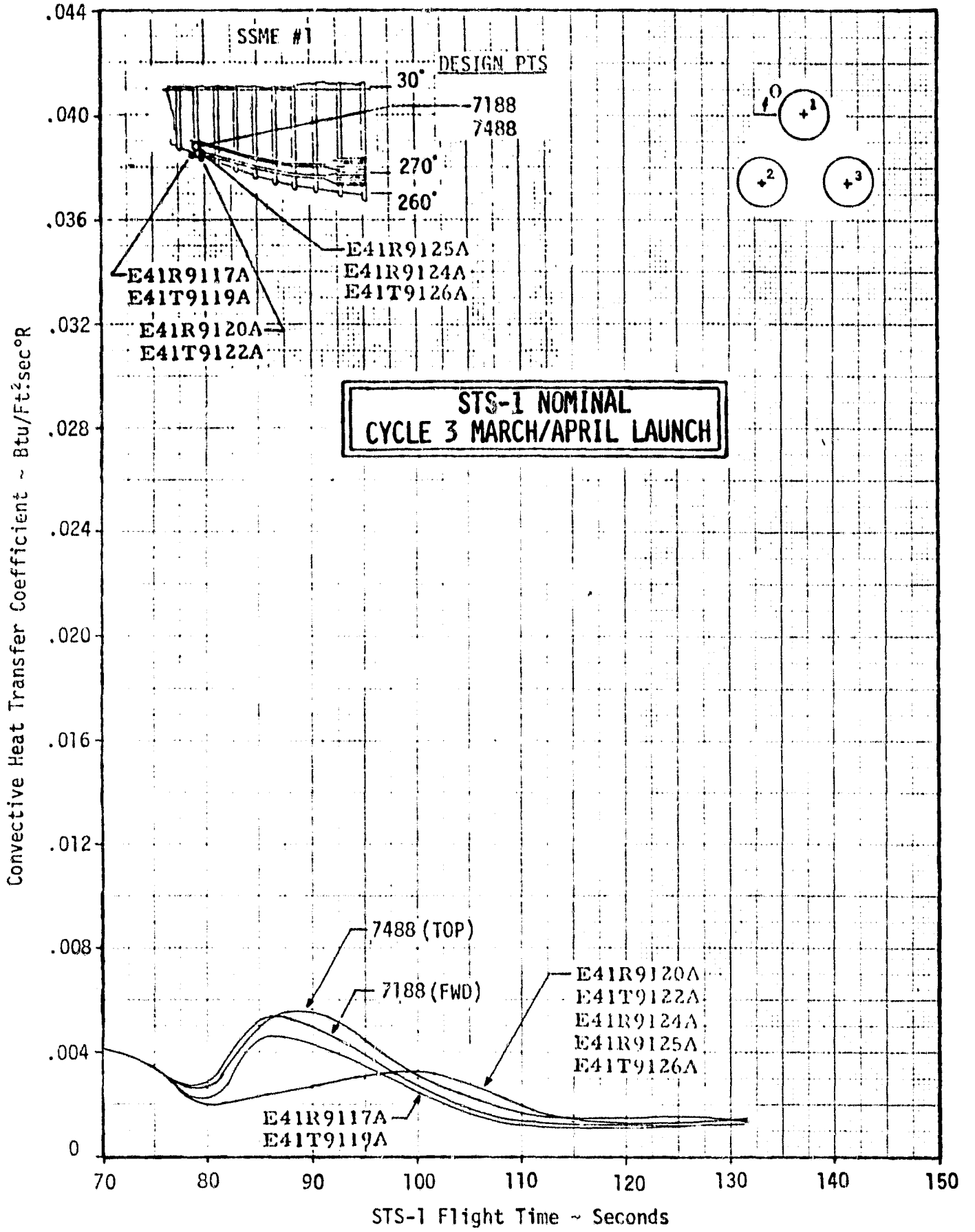

Figure 13 STS-1 First Stage Convective Base Heating Environment - SSME #1

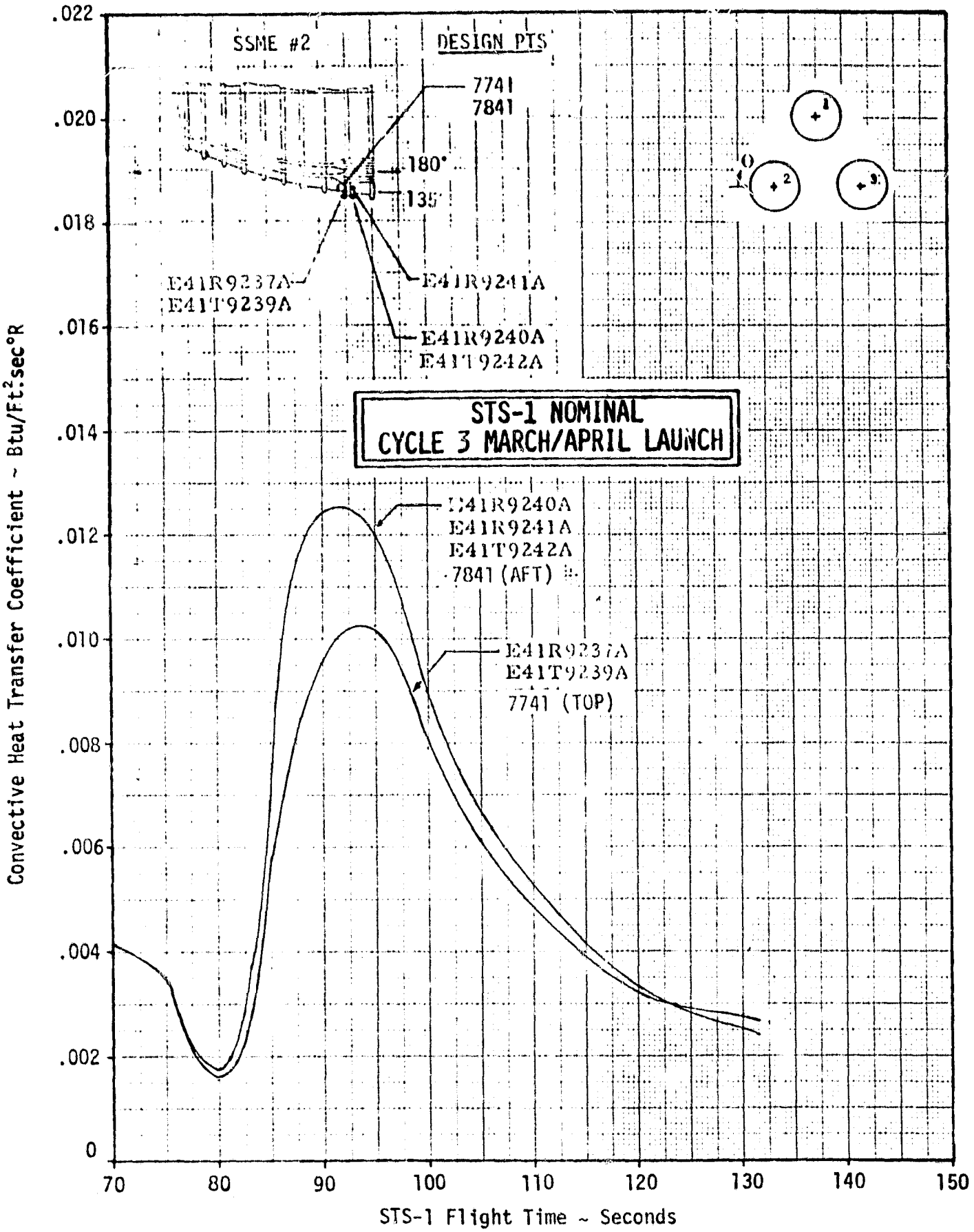

Figure 14. STS-1 First Stage Convective Base Heating Environment - SSME #2

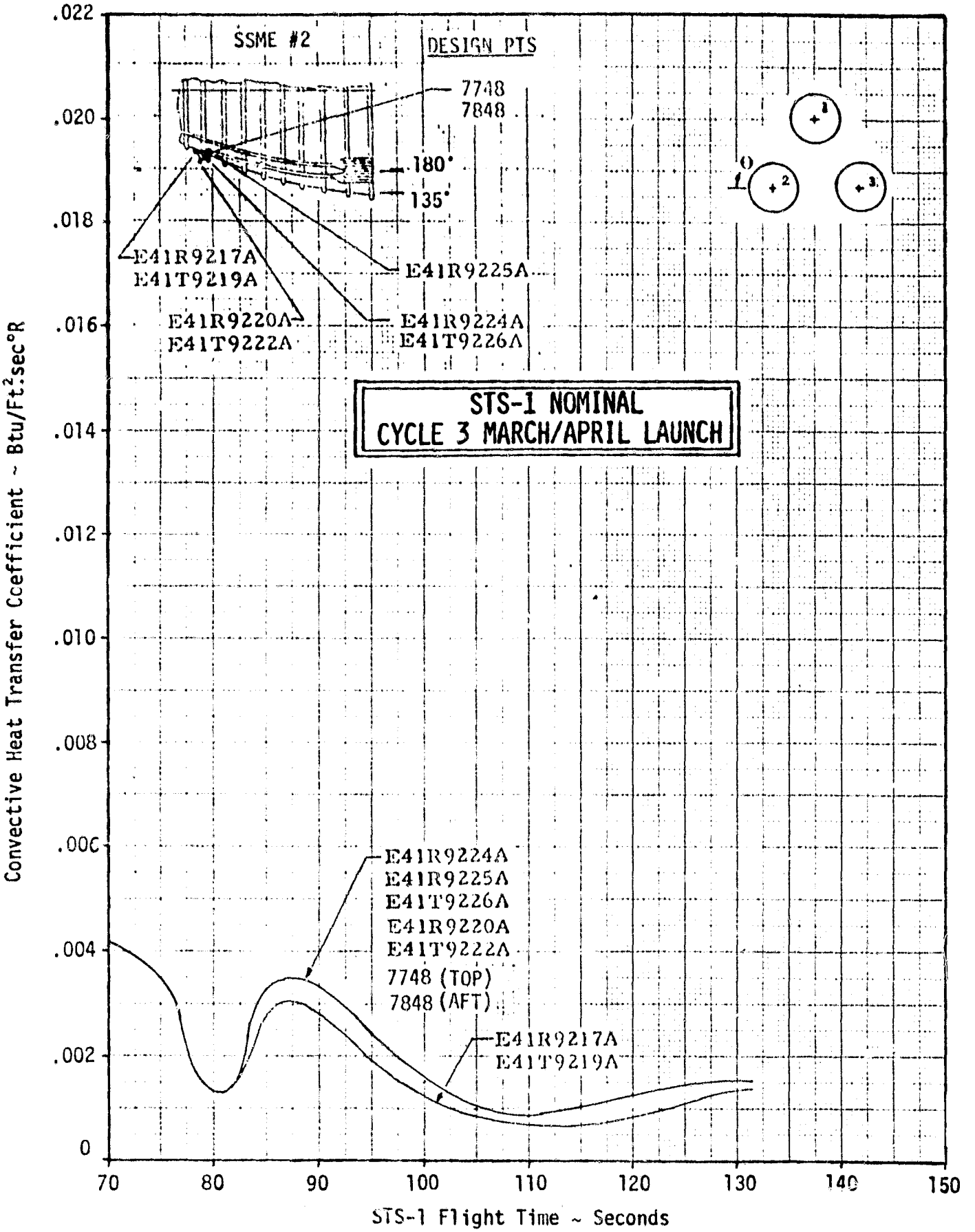

Figure 15 STS-1 First Stage Convective Base Heating Environment - SSME #2

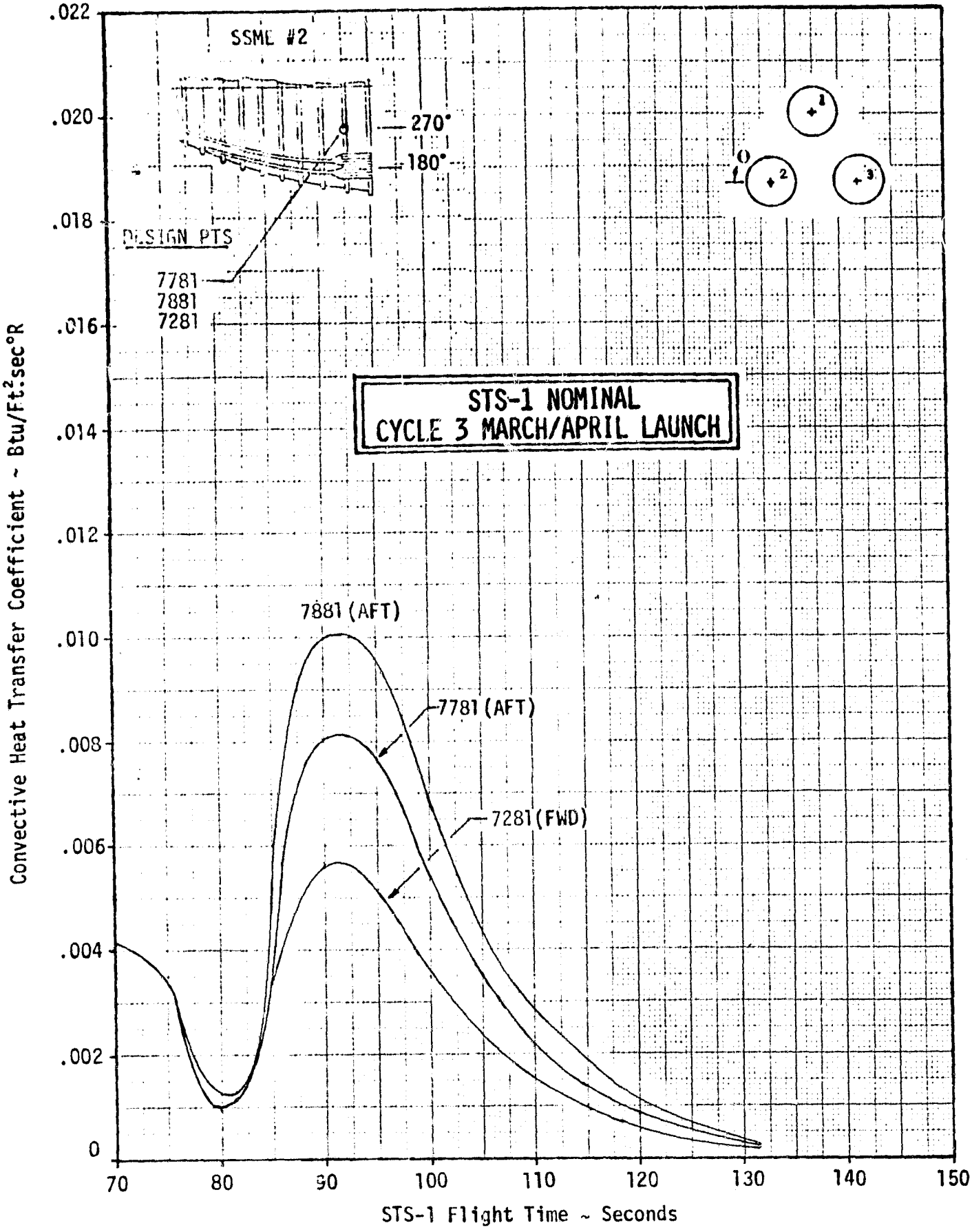

Figure 16. STS-1 First Stage Convective Base Heating Environment - SSME #2

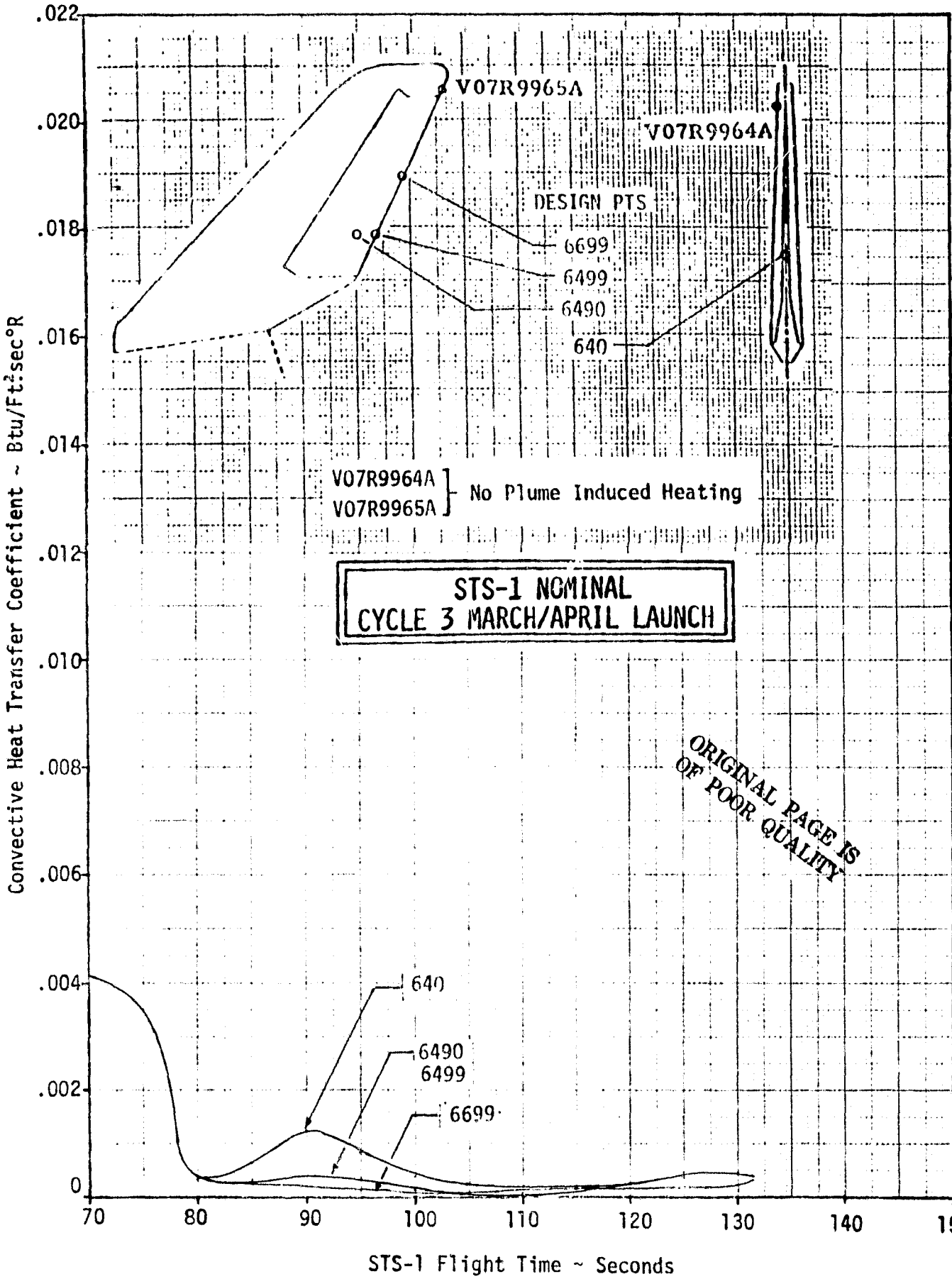

Figure 17 . STS-1 First Stage Convective Base Heating Environment - Vertical Tail

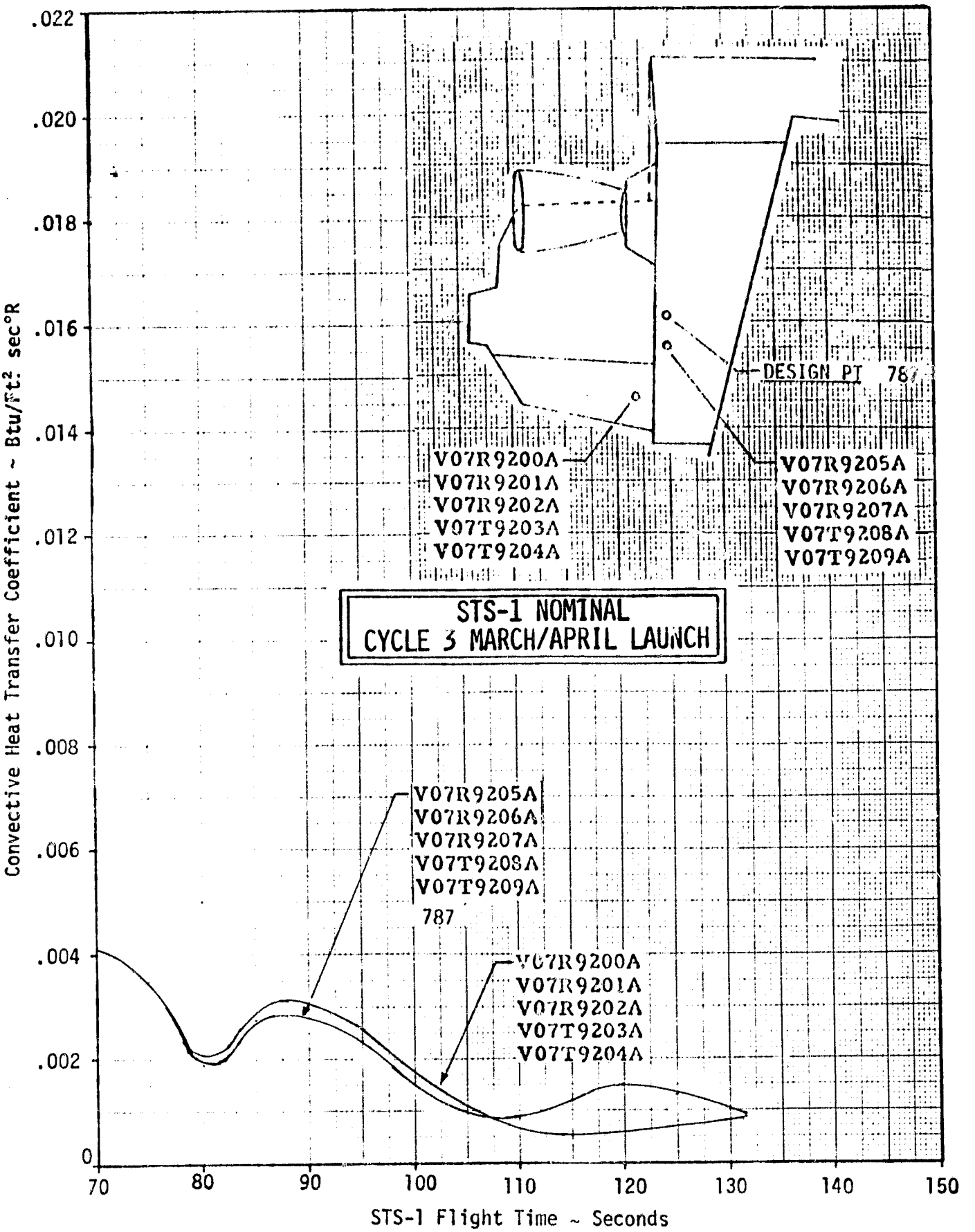

Figure 18. STS-1 First Stage Convective Base Heating Environment ~ OMS Pod

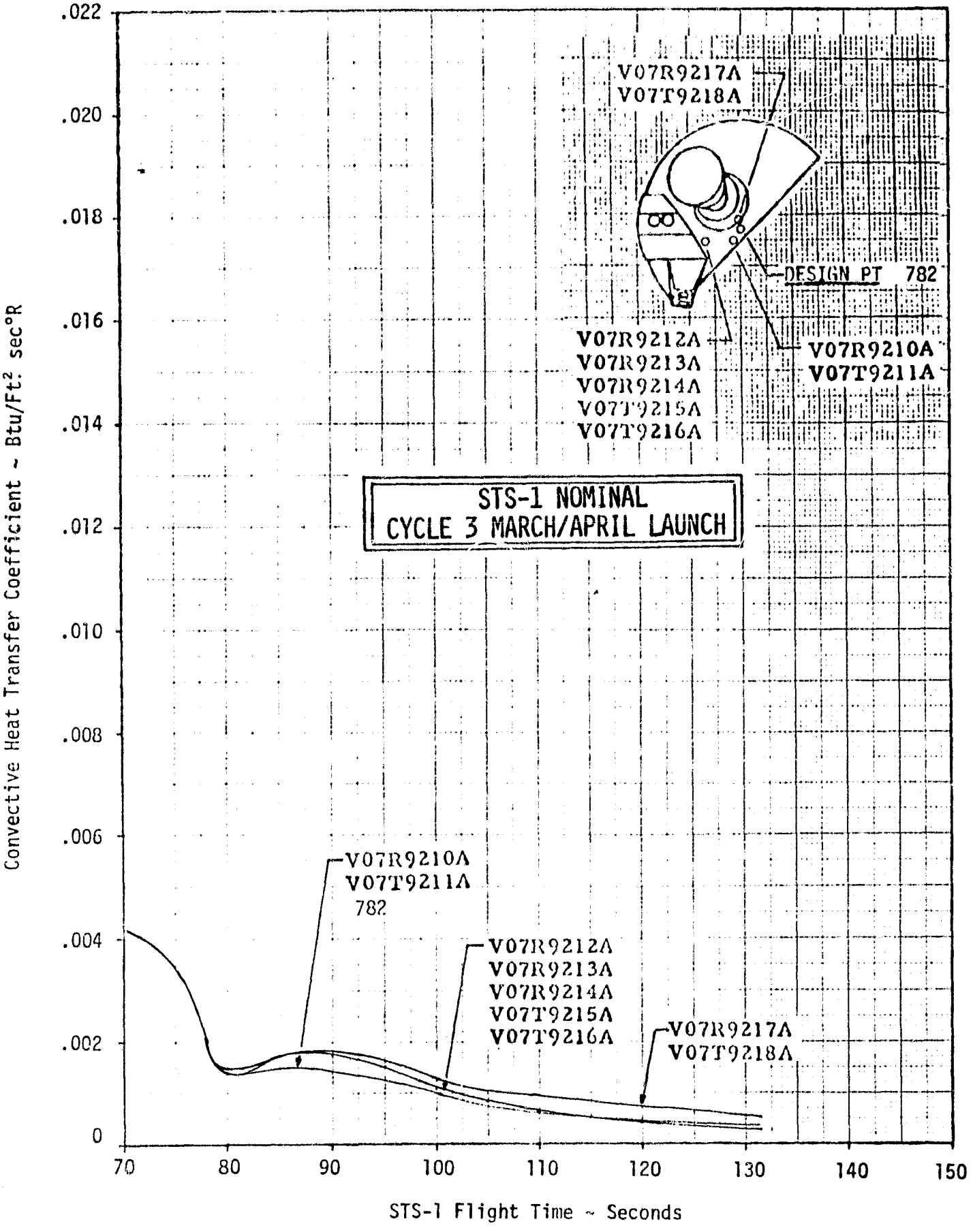

Figure 19. STS-1 First Stage Convective Base Heating Environment - OMS Pod

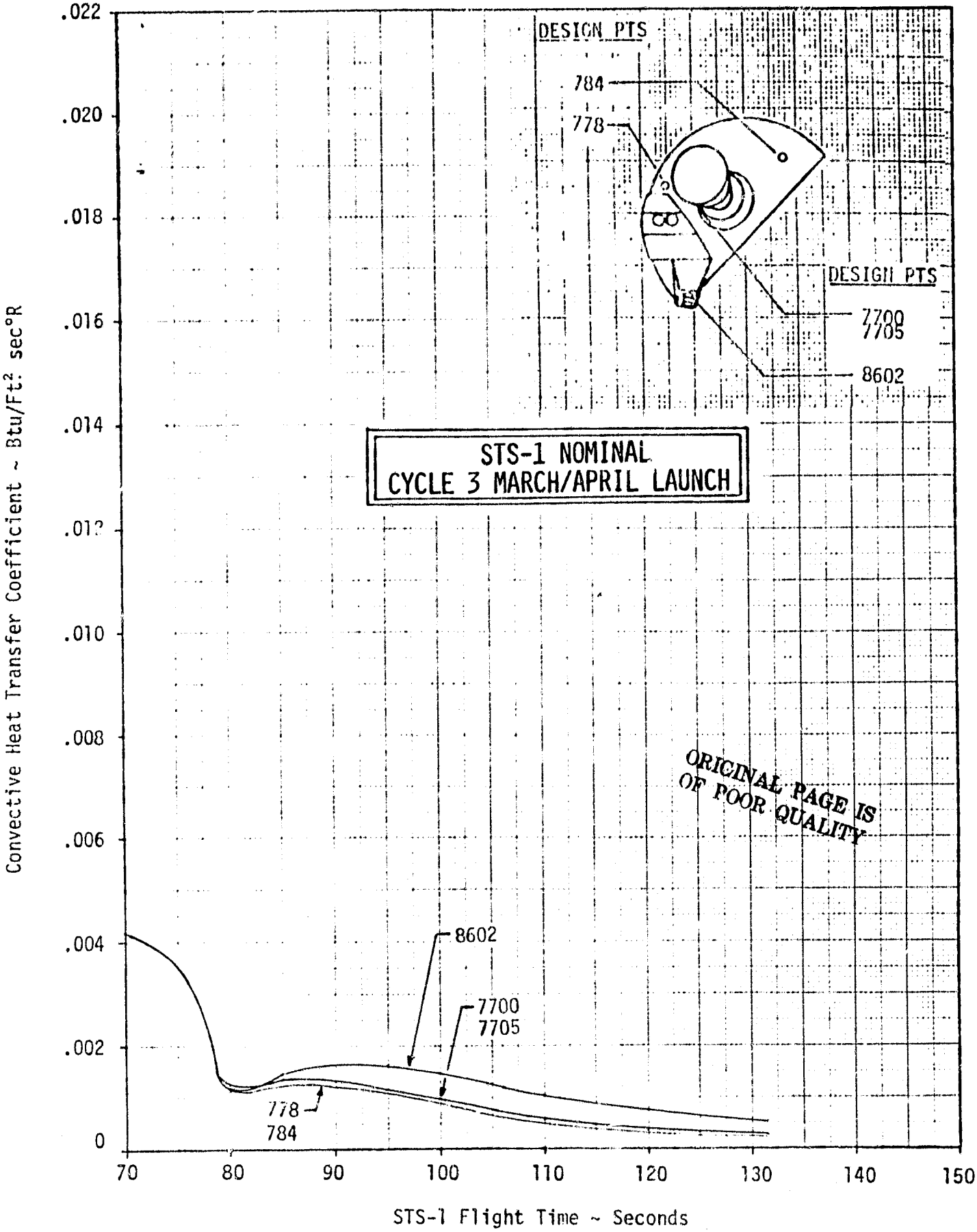

Figure 20. STS-1 First Stage Convective Base Heating Environment - OMS Pod

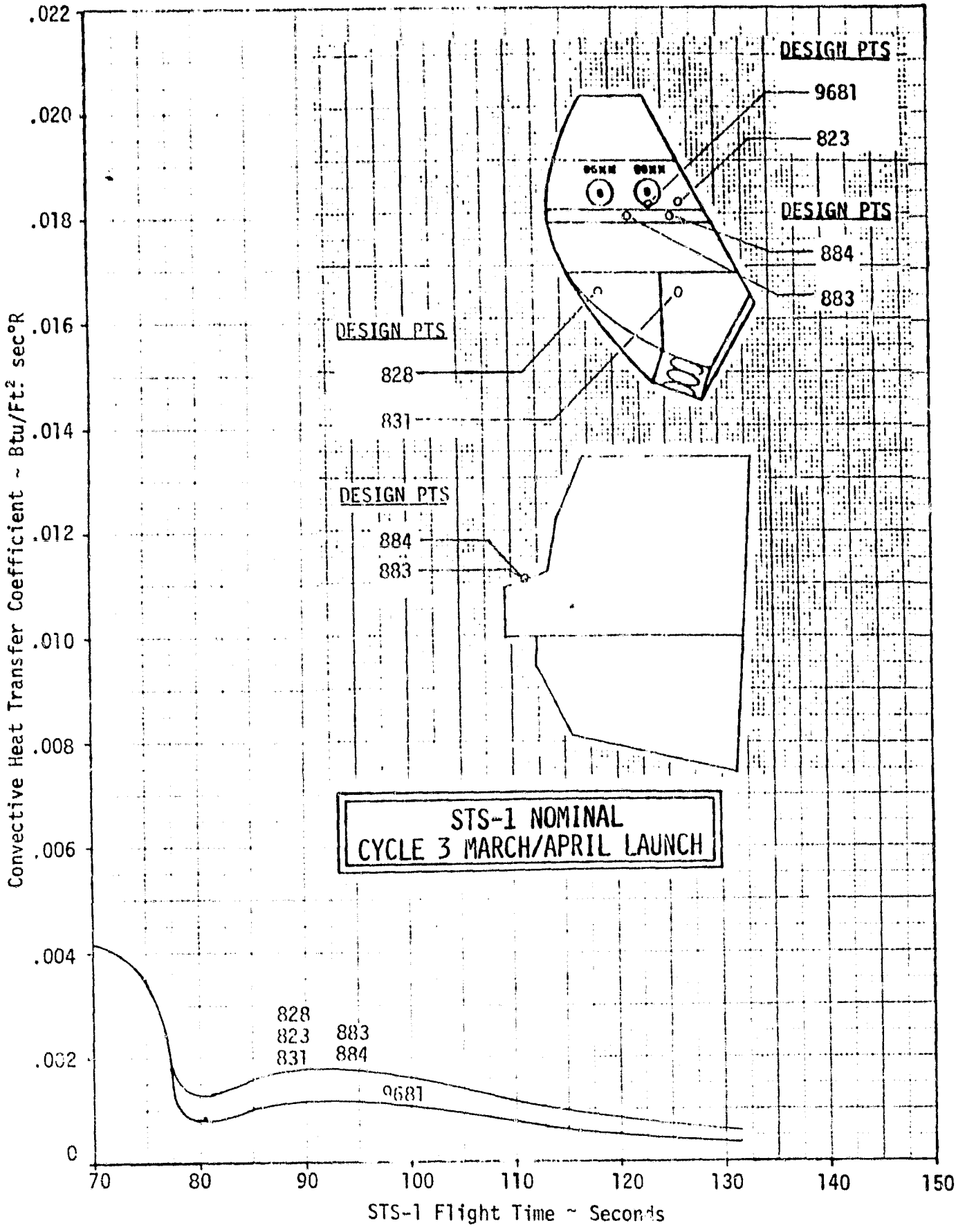

Figure 21. STS-1 First Stage Convective Base Heating Environment - OMS Pod

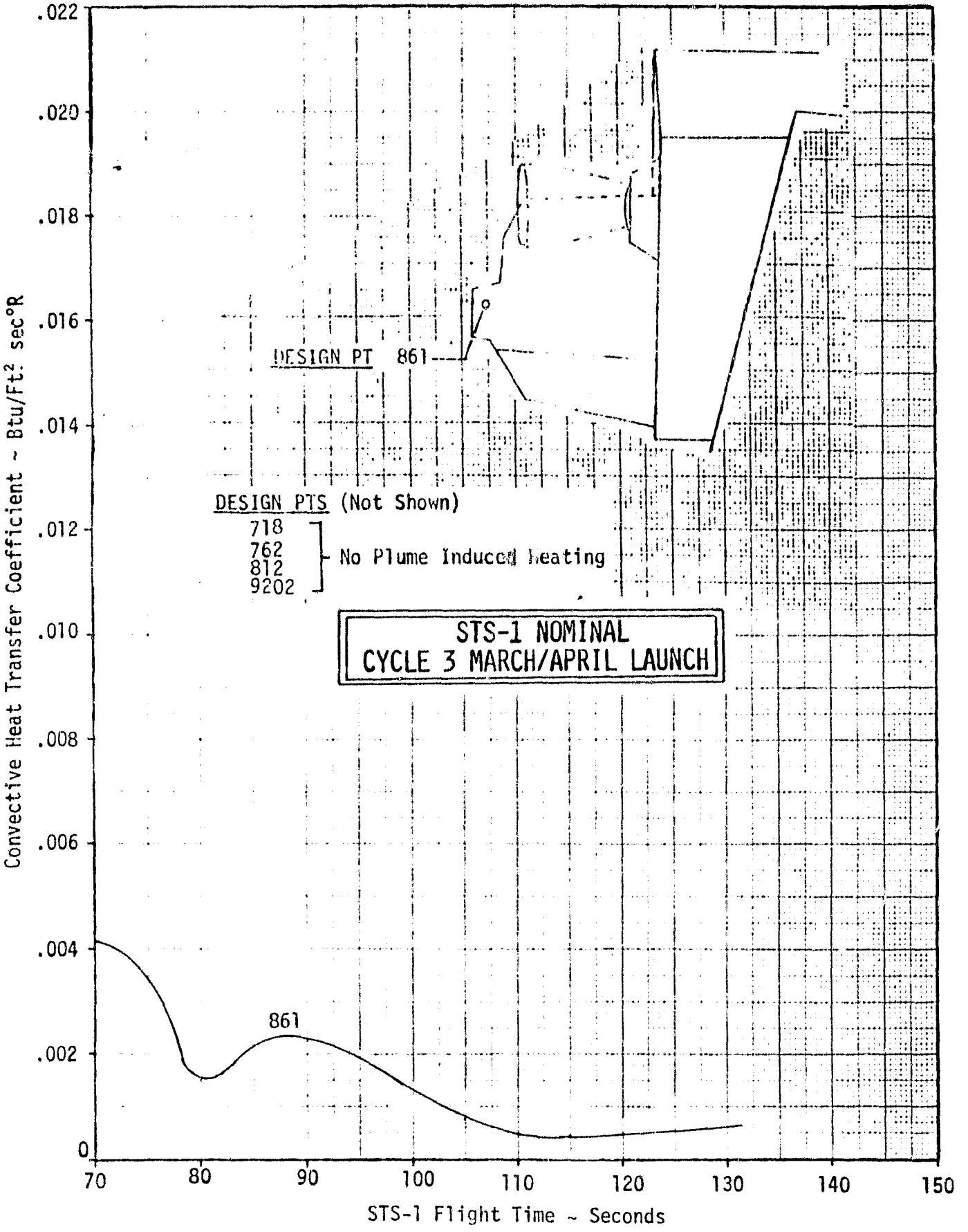

Figure 22. STS-1 First Stage Convective Base Heating Environment - OMS Pod

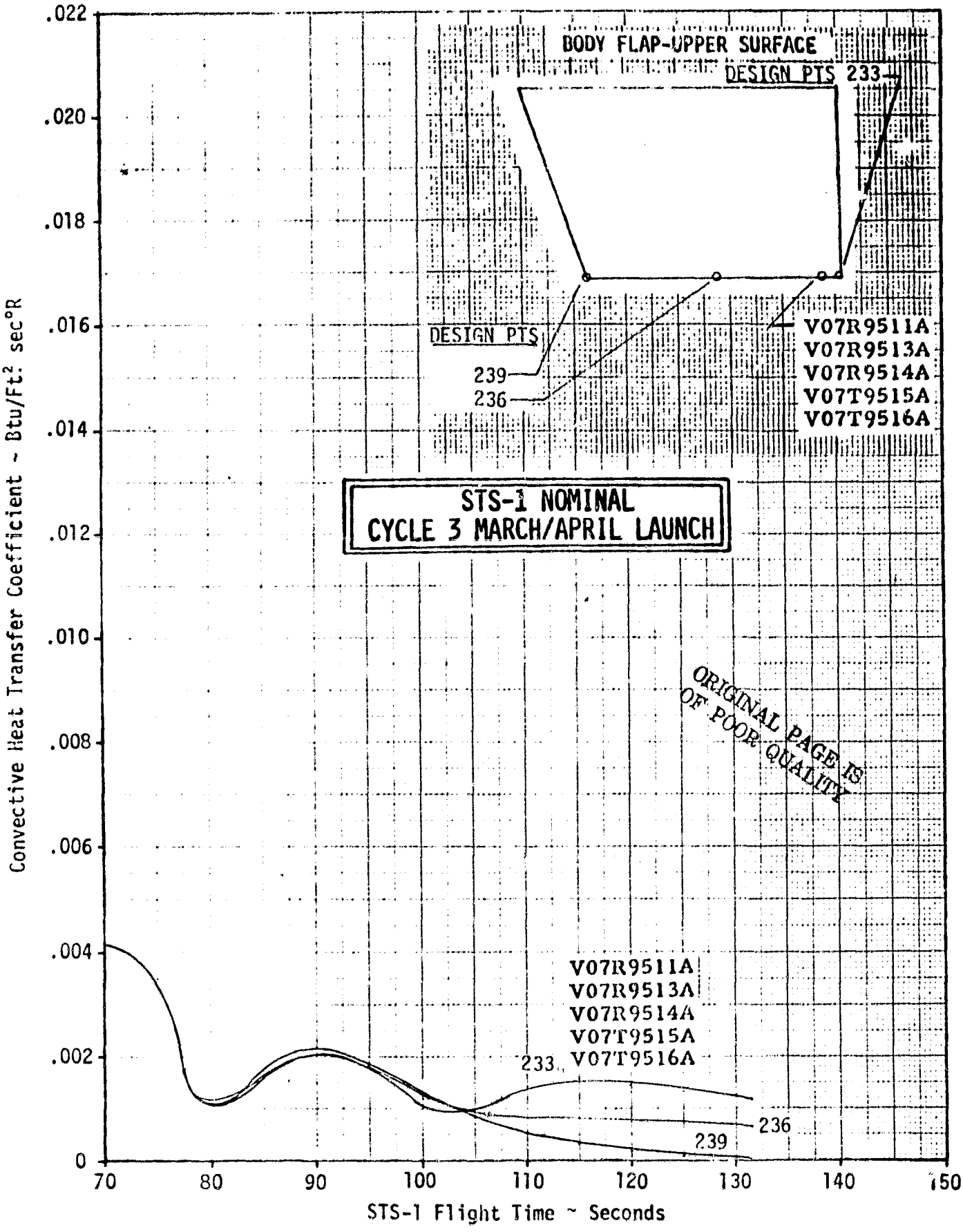

Figure 23. STS-1 First Stage Convective Base Heating Environment - Body Flap

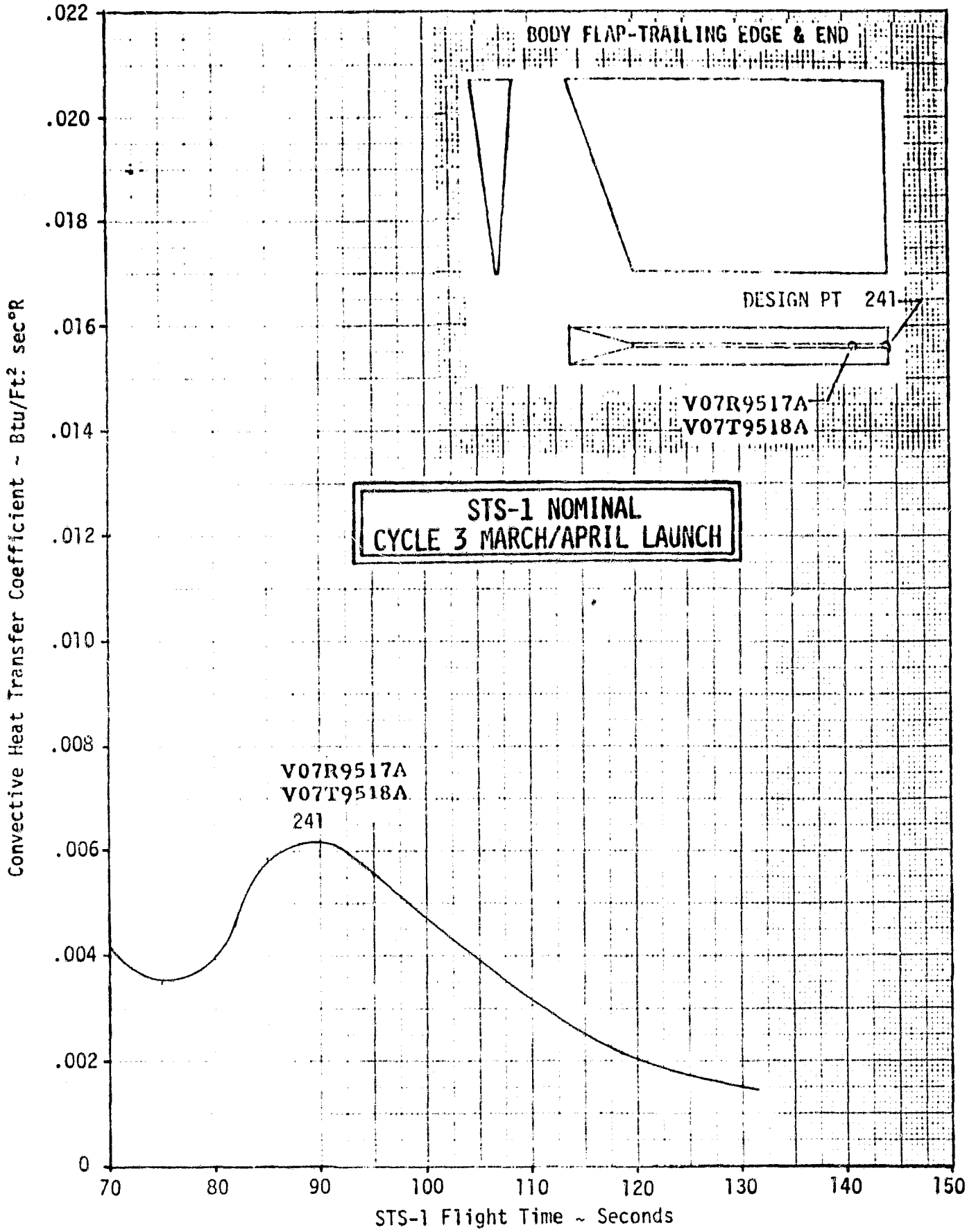

Figure 24. STS-1 First Stage Convective Base Heating Environment - Body Flap

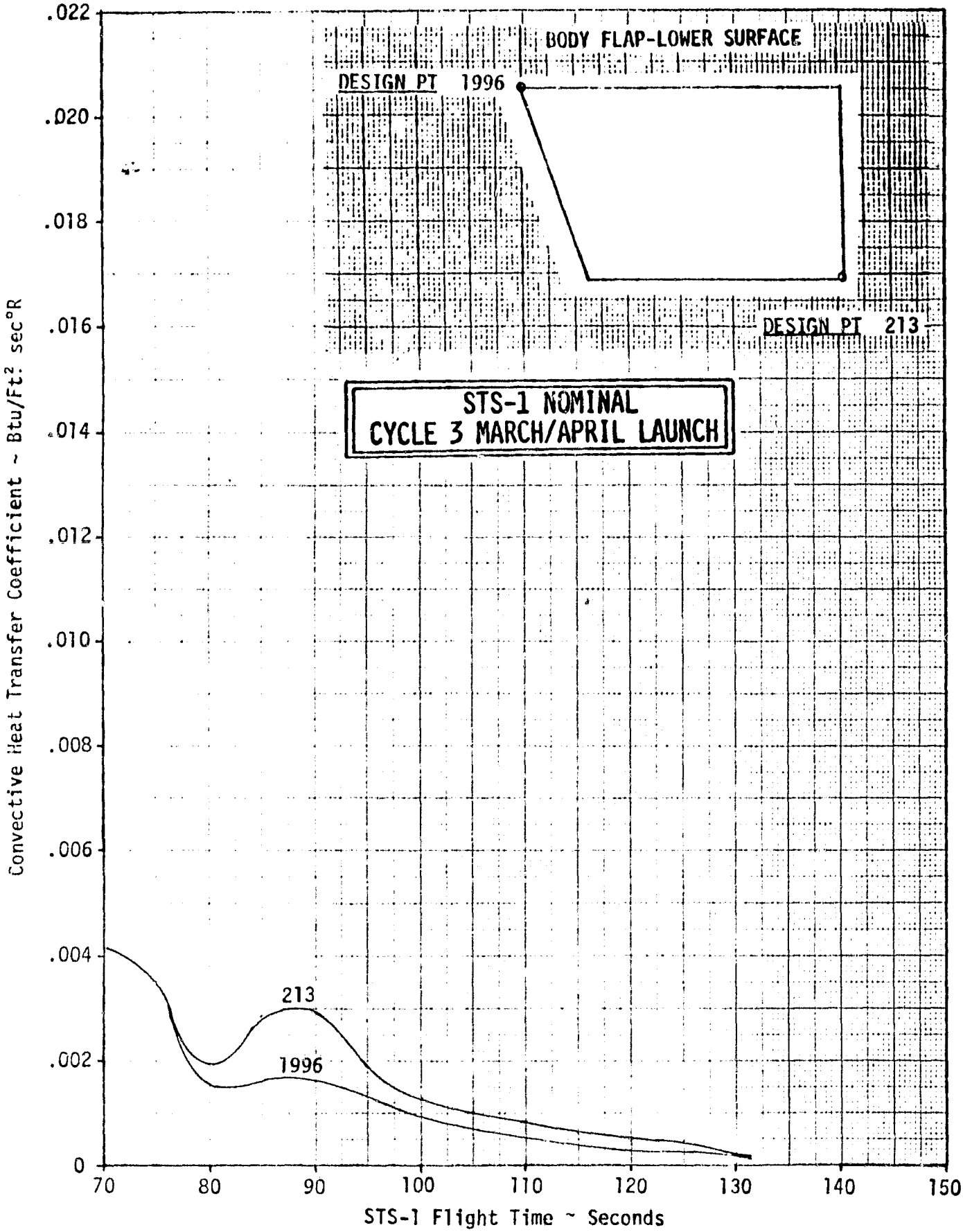

Figure 25. STS-1 First Stage Convective Base Heating Environment - Body Flap

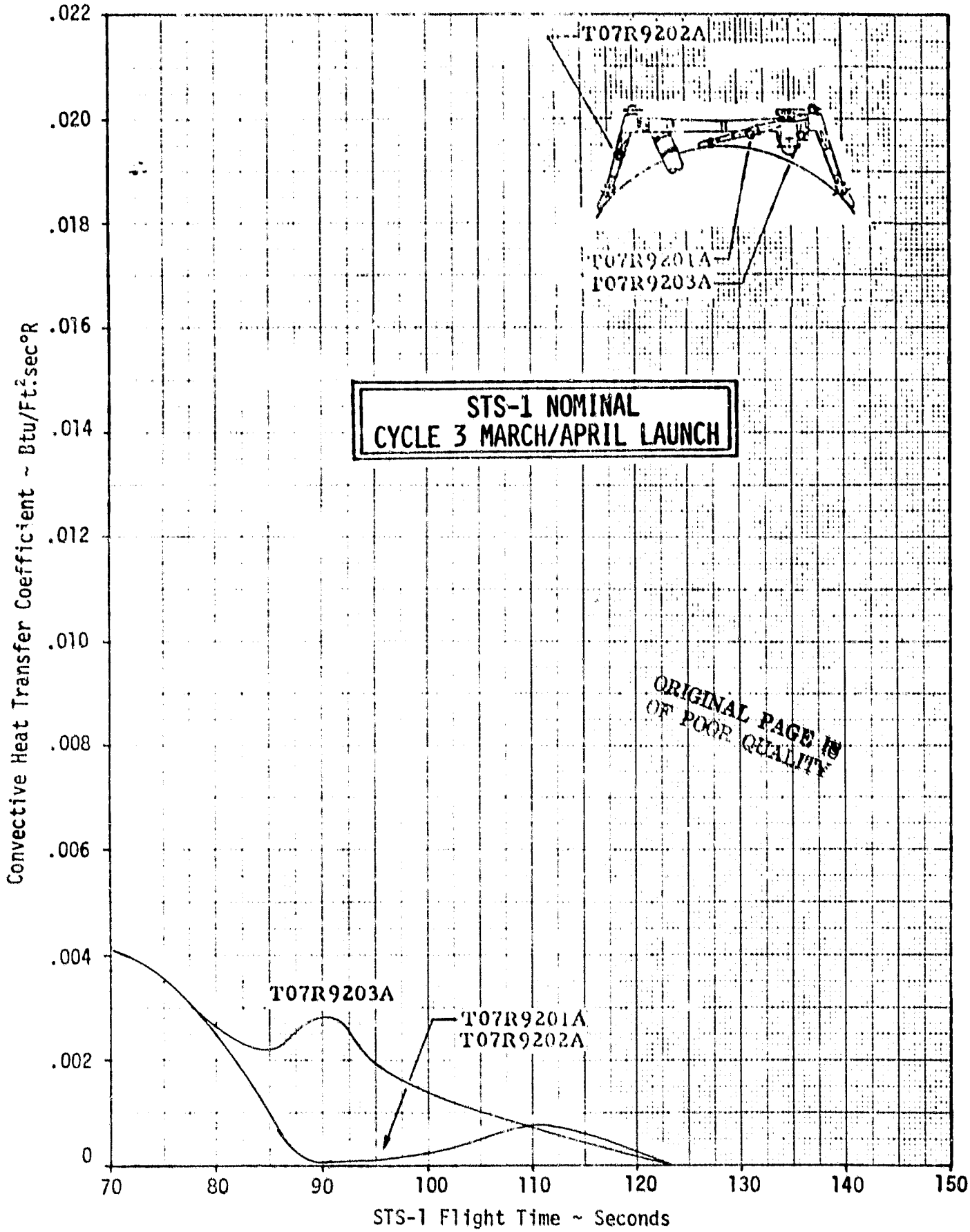

Figure 26. STS-1 First Stage Convective Base Heating Environment - AFT Attach Structure

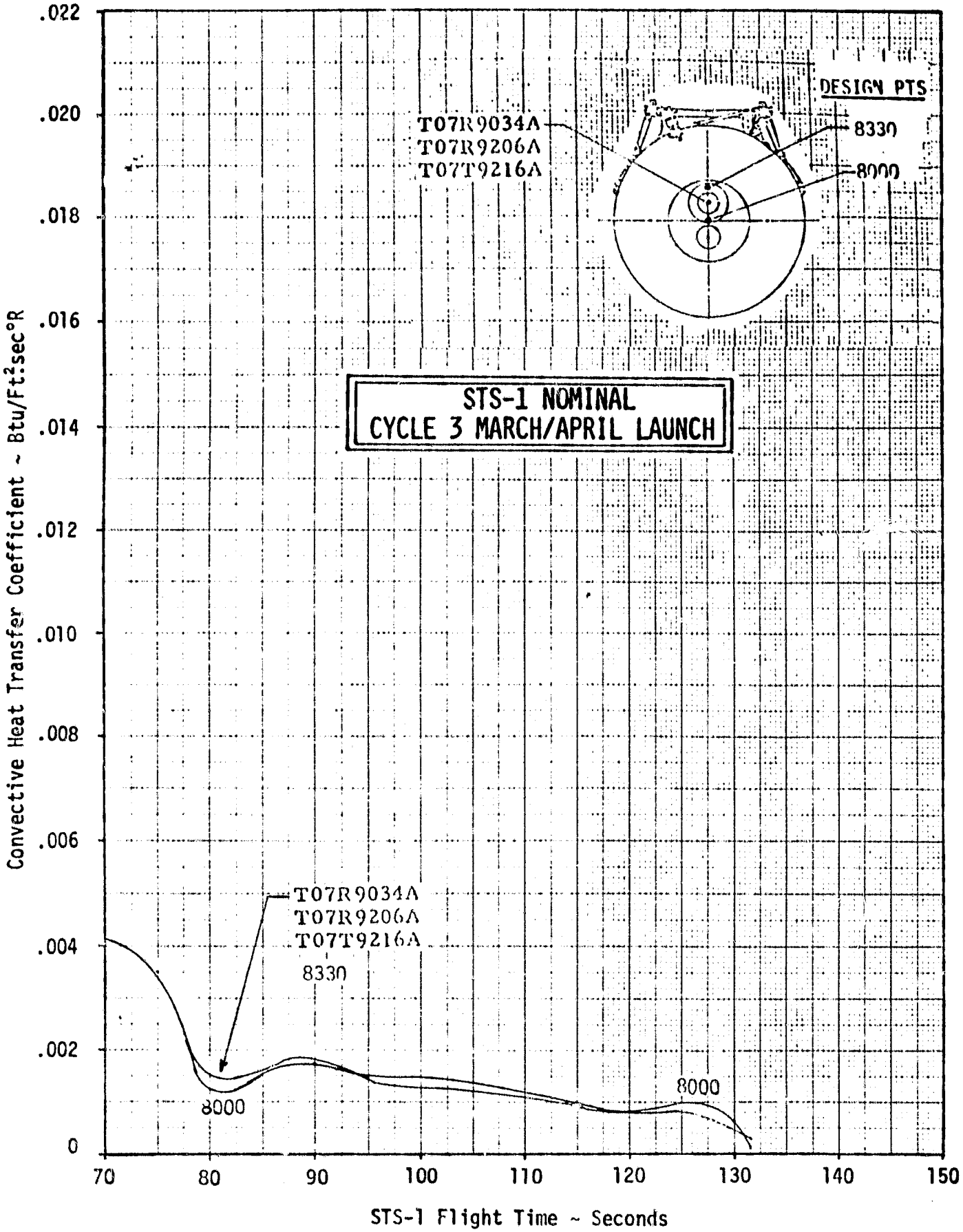

Figure 27. STS-1 First Stage Convective Base Heating Environment - ET Dome

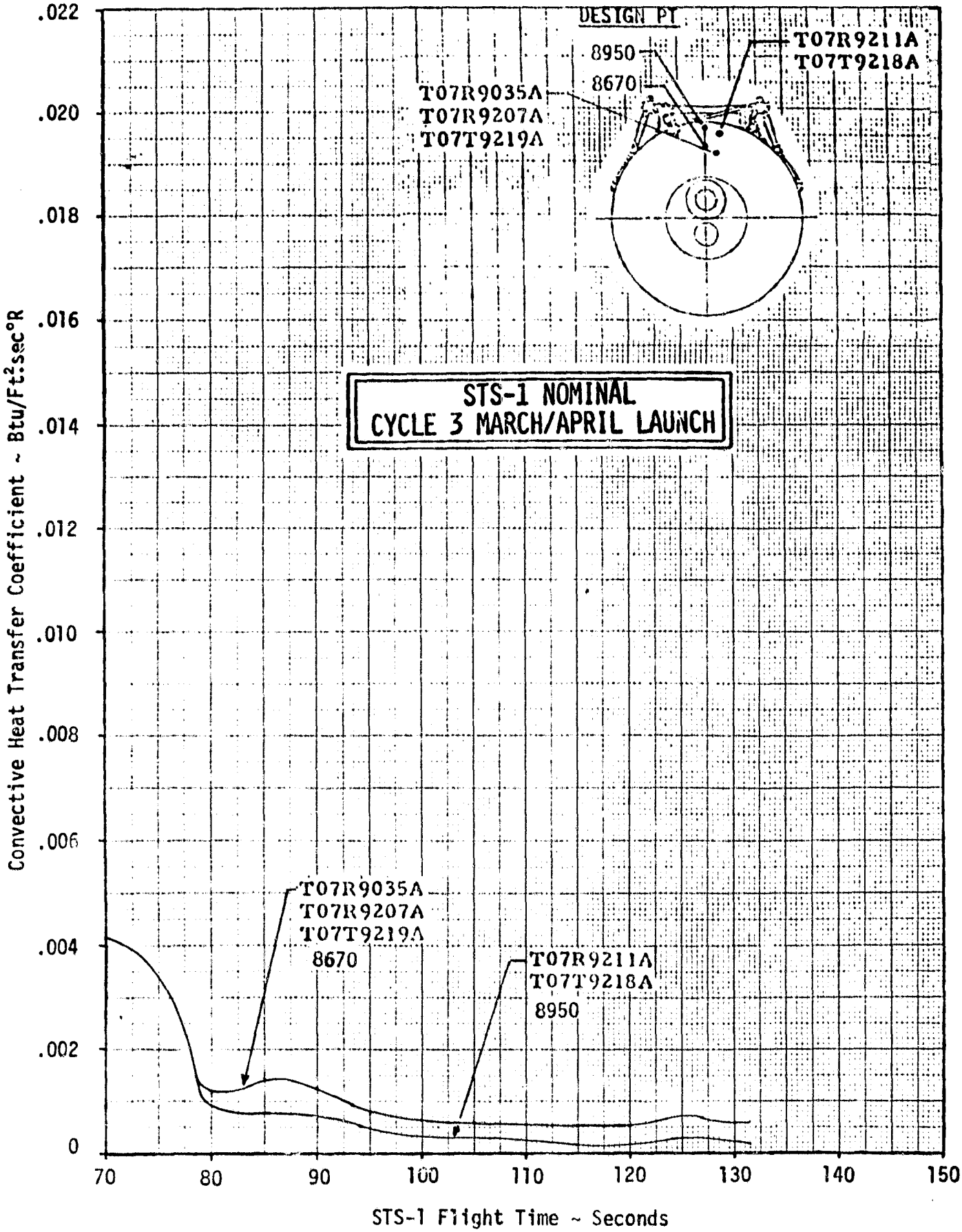

Figure 28. STS-1 First Stage Convective Base Heating Environment - ET Dome

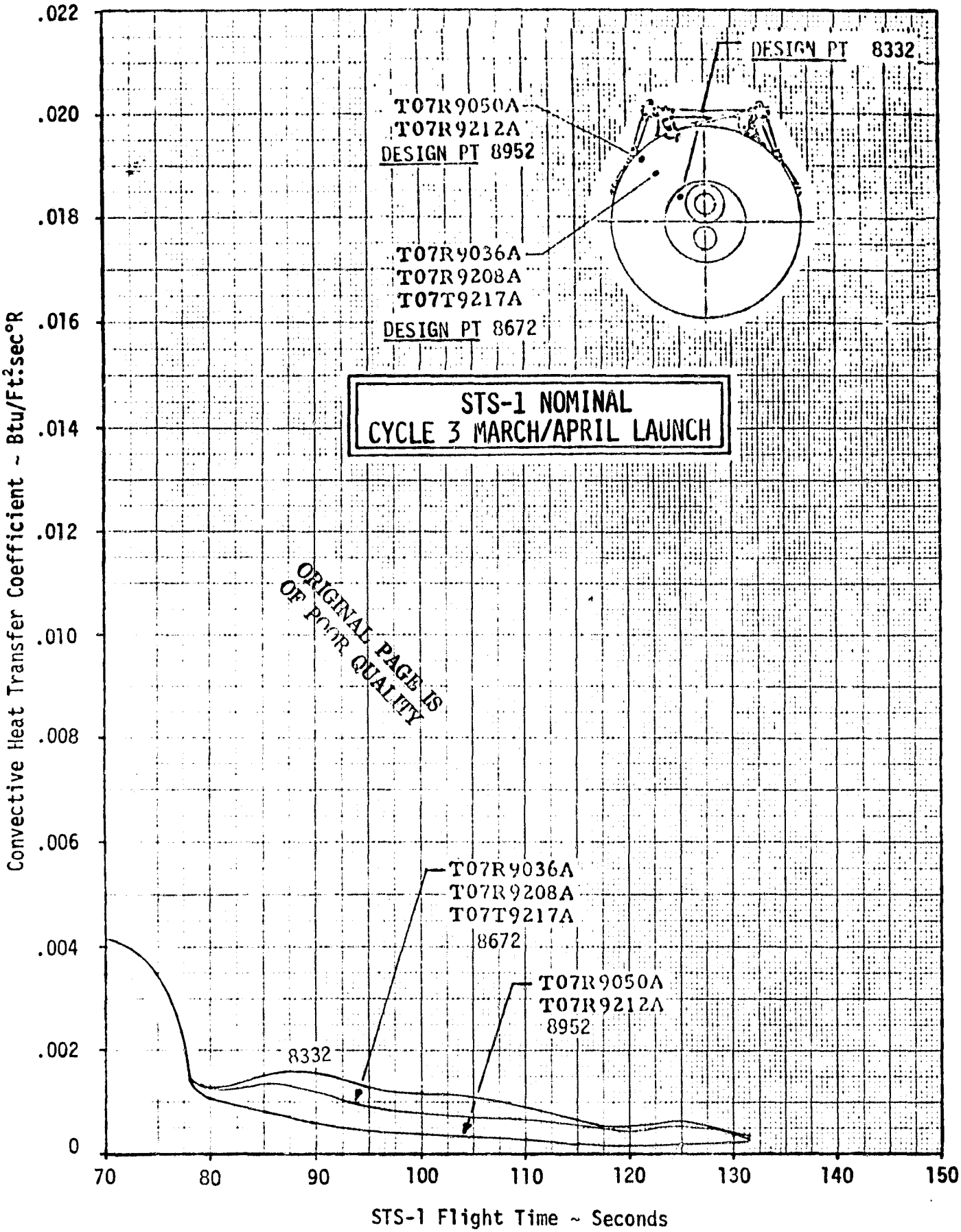

Figure 29. STS-1 First Stage Convective Base Heating Environment - ET Dome

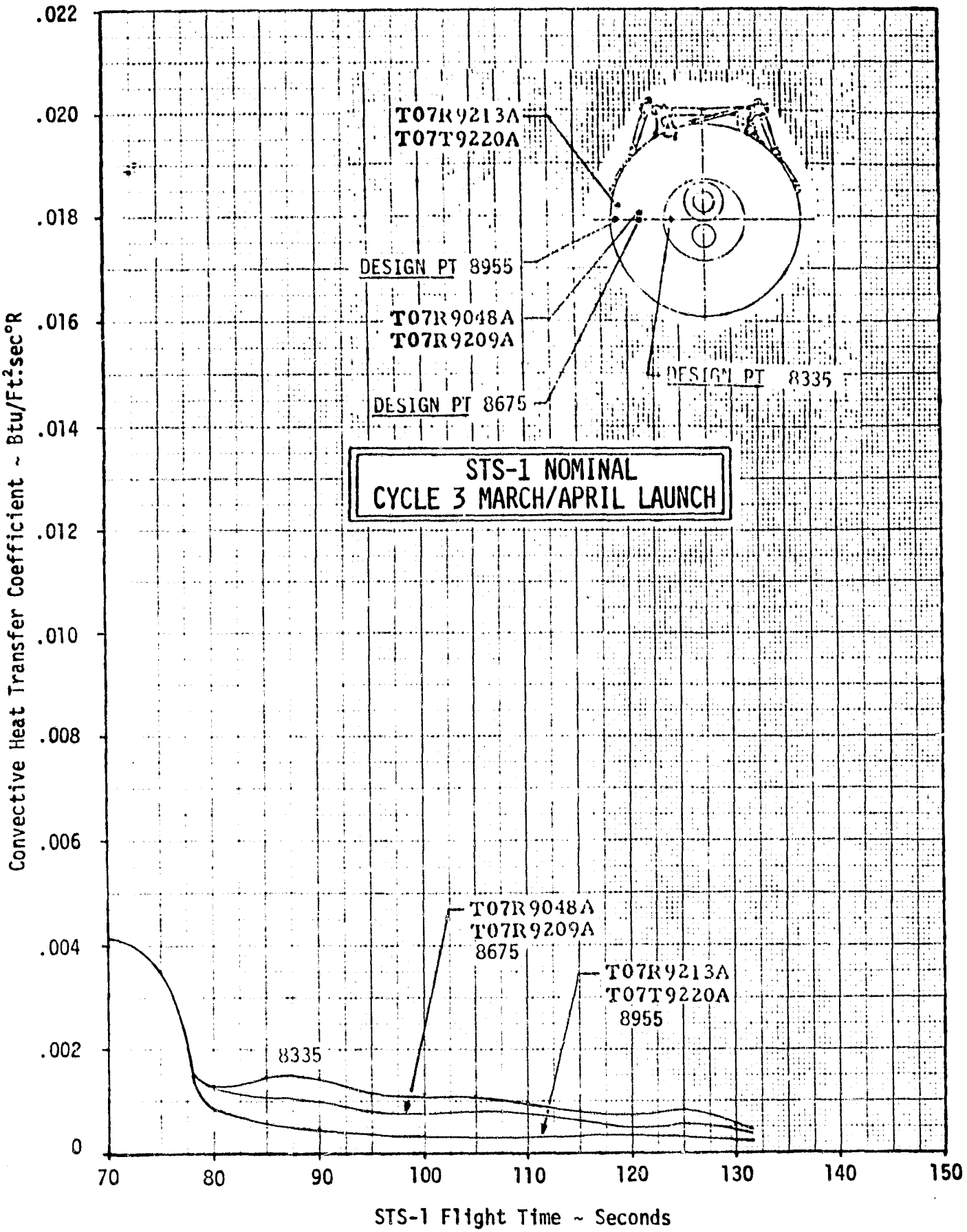

Figure 30. STS-1 First Stage Convective Base Heating Environment - ET Dome

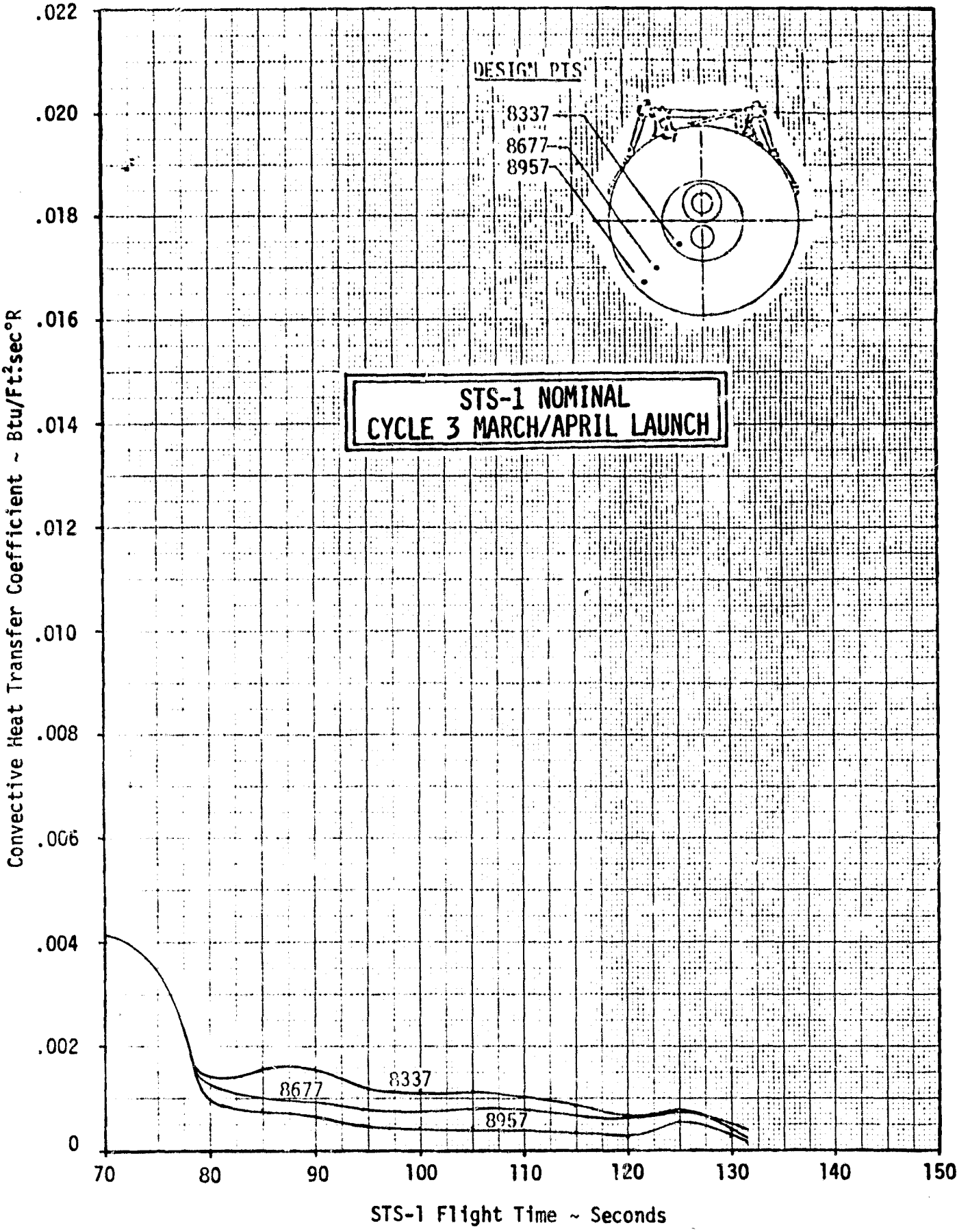

Figure 31. STS-1 First Stage Convective Base Heating Environment - ET Dome

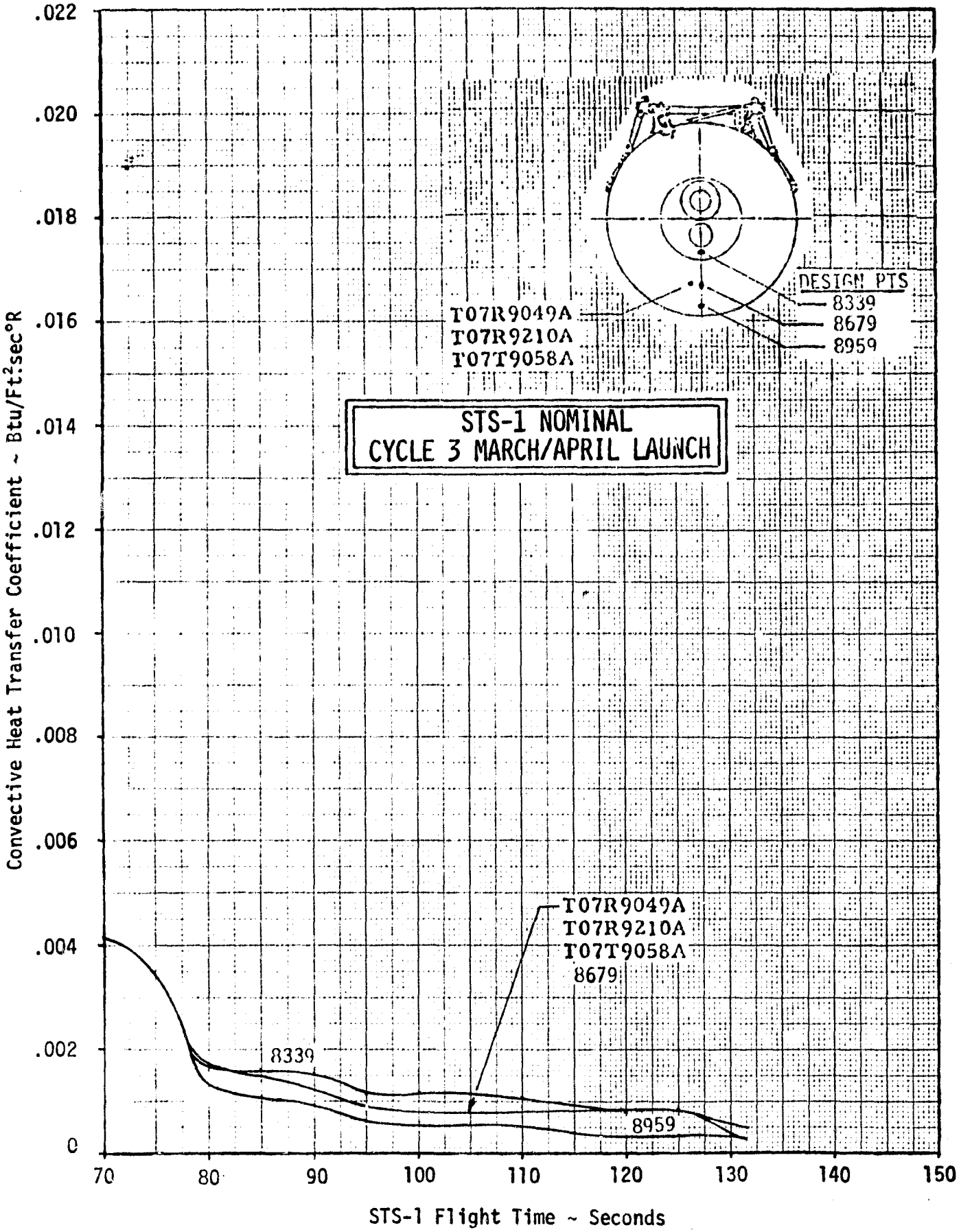

Figure 32. STS-1 First Stage Convective Base Heating Environment - ET Dome

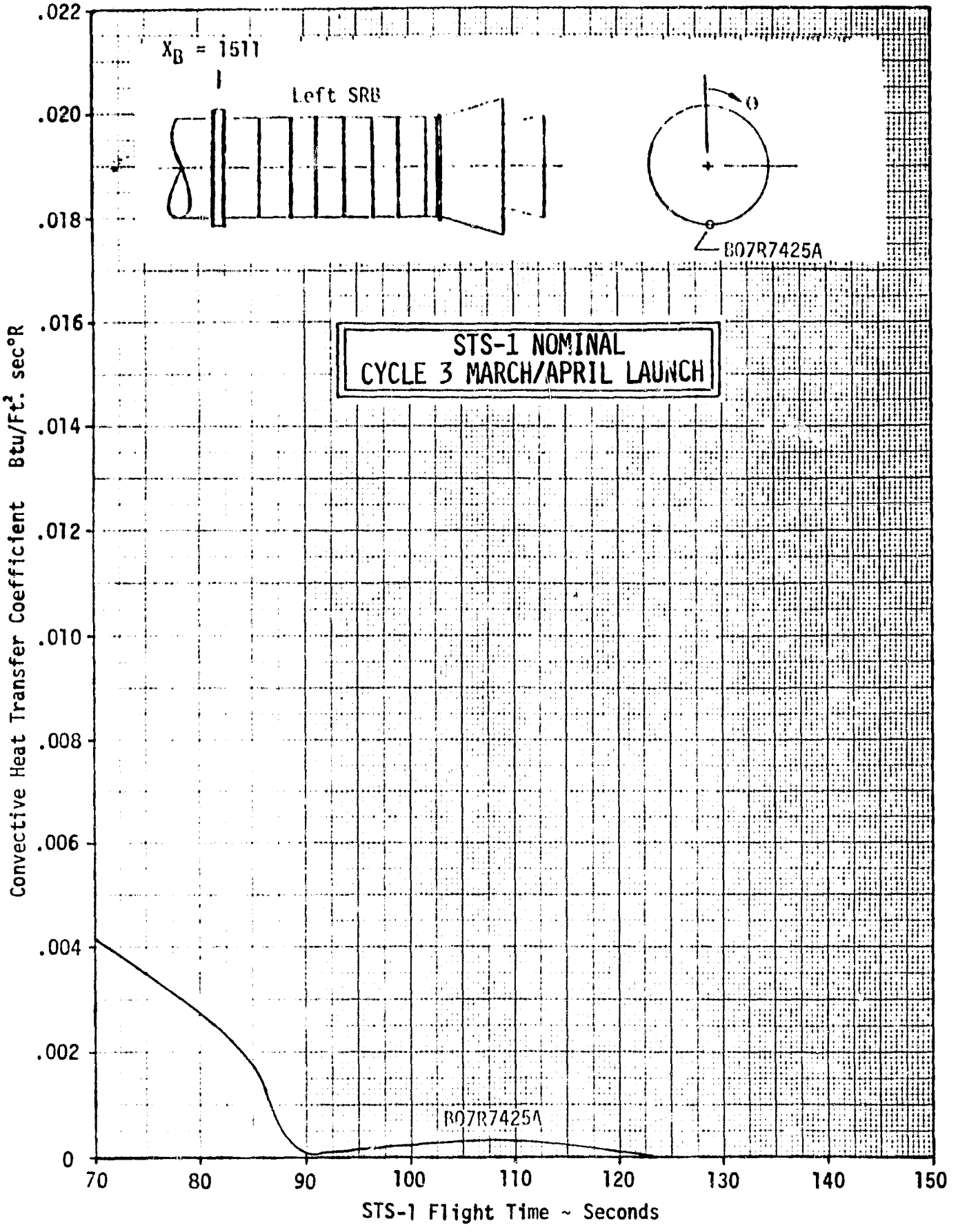

Figure 33. STS-1 First Stage Convective Base Heating Environment - Left SRB

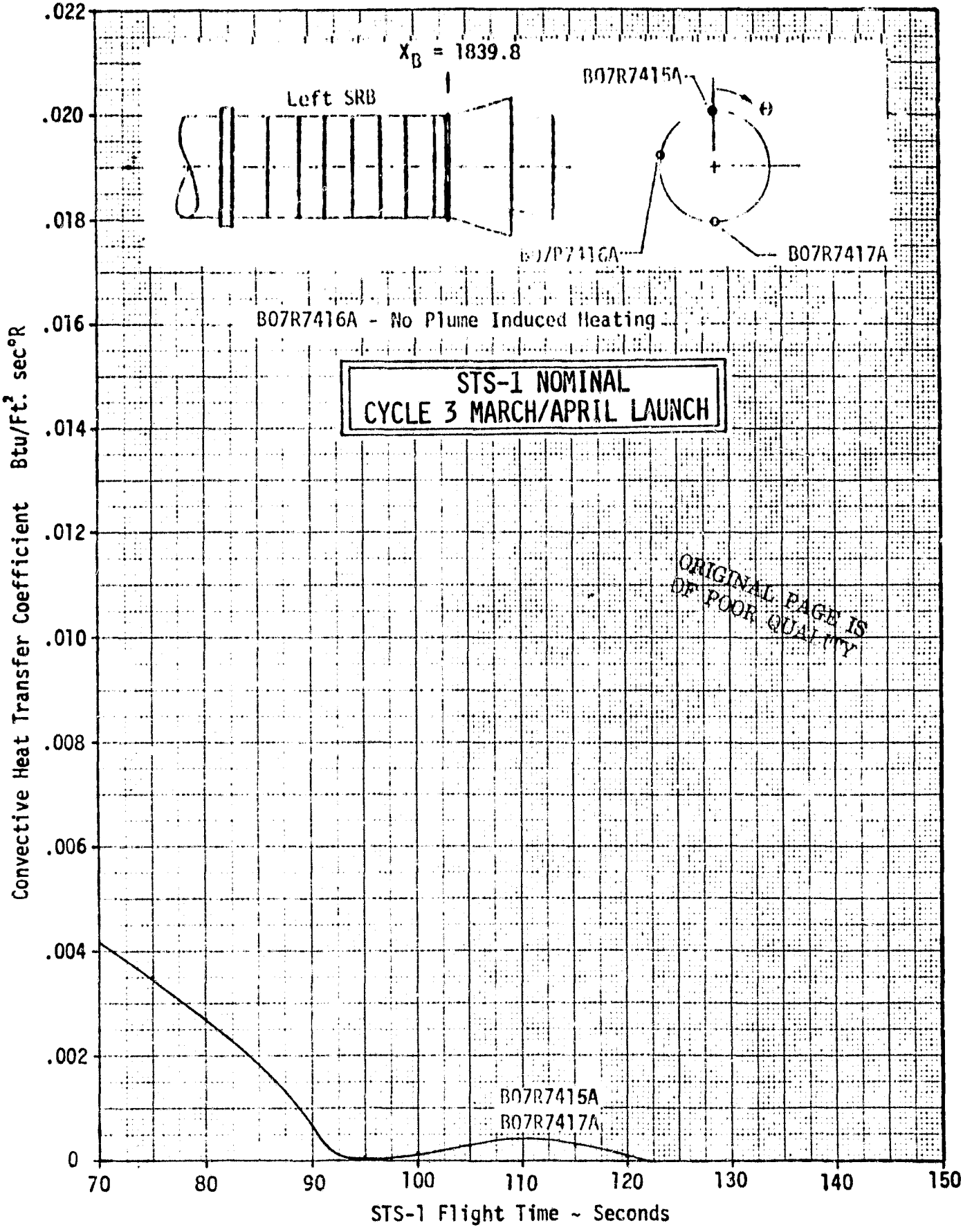

Figure 34. STS-1 First Stage Convective Base Heating Environment - Left SRB

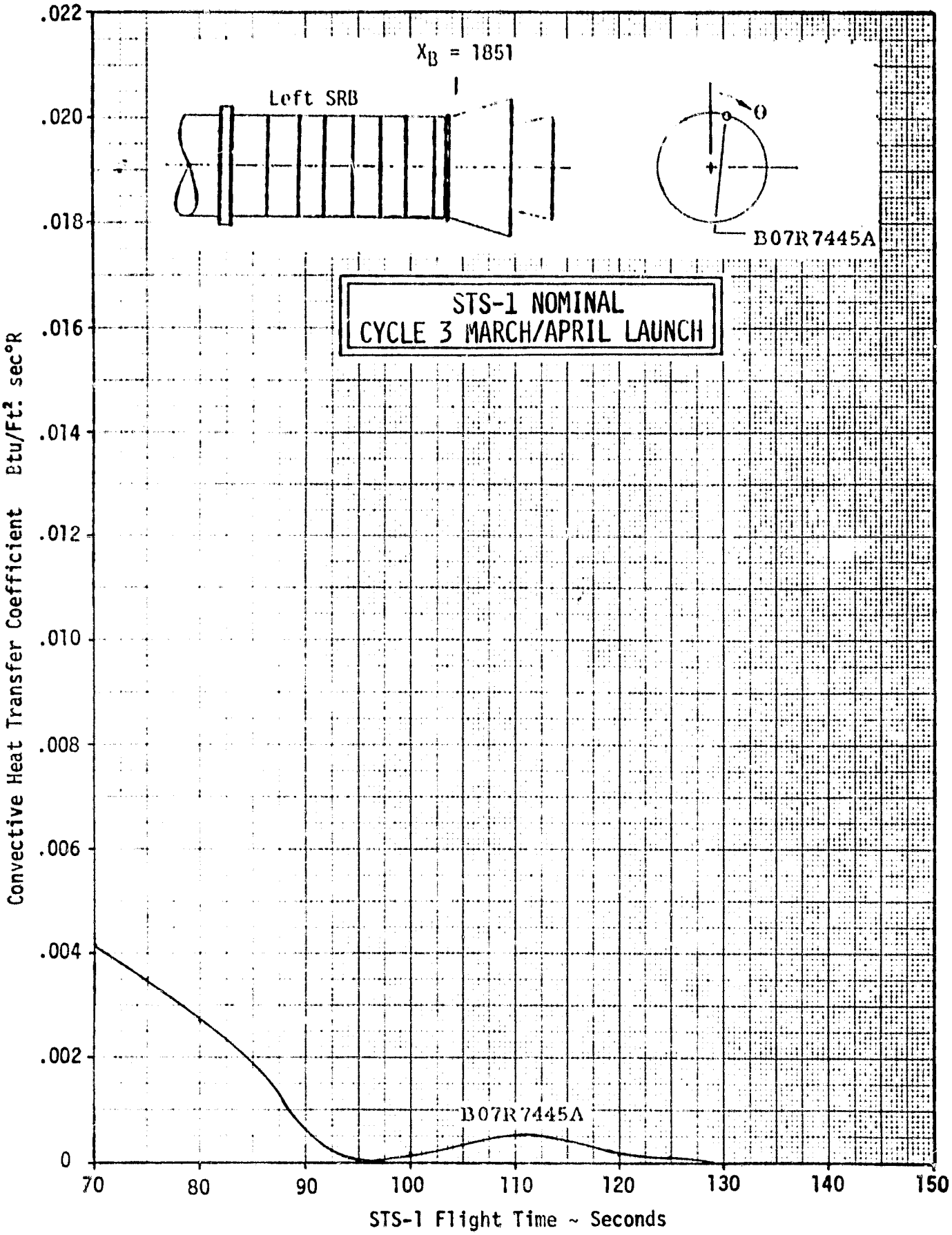

Figure 35. STS-1 First Stage Convective Base Heating Environment - Left SRB

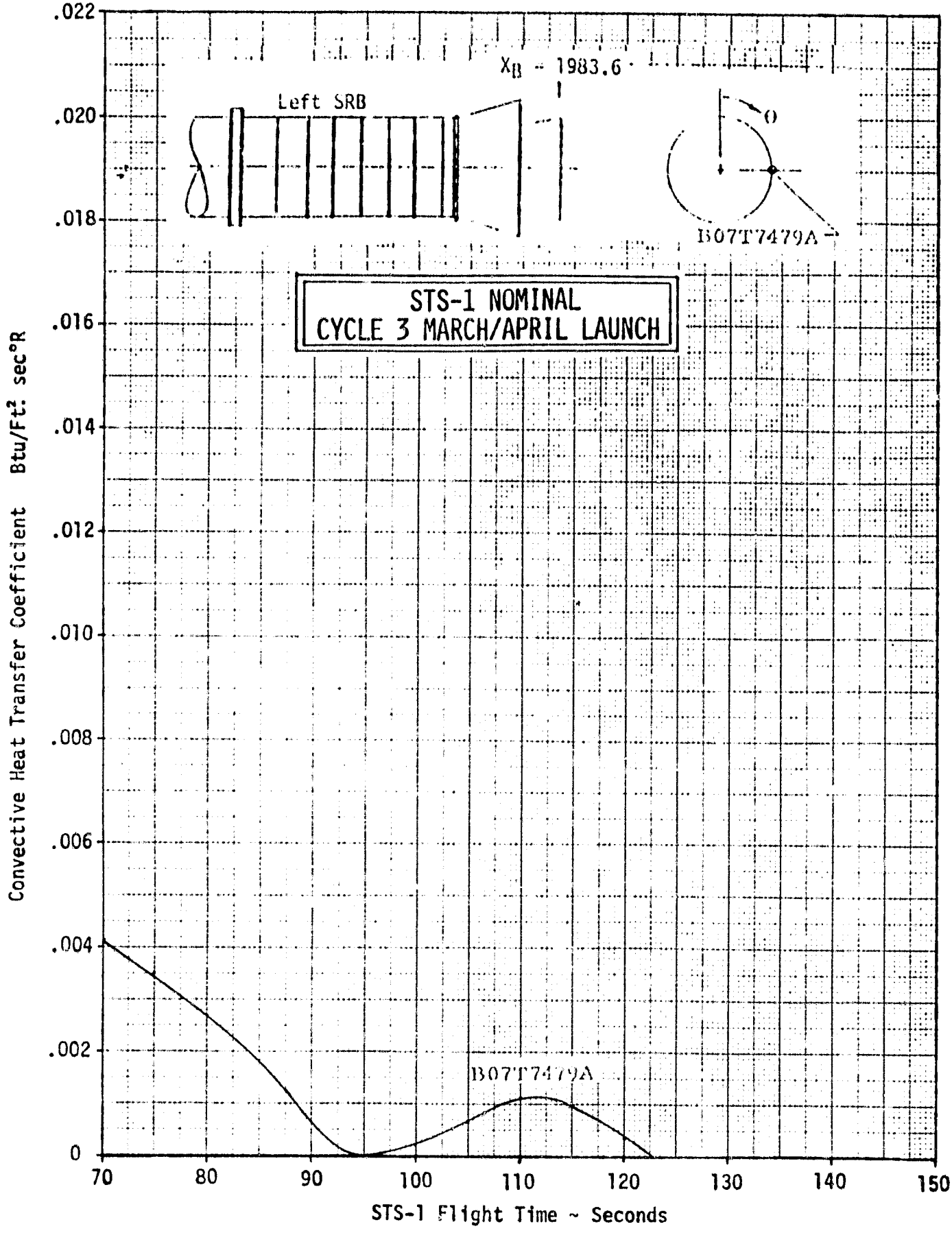

Figure 36. STS-1 First Stage Convective Base Heating Environment - Left SRB

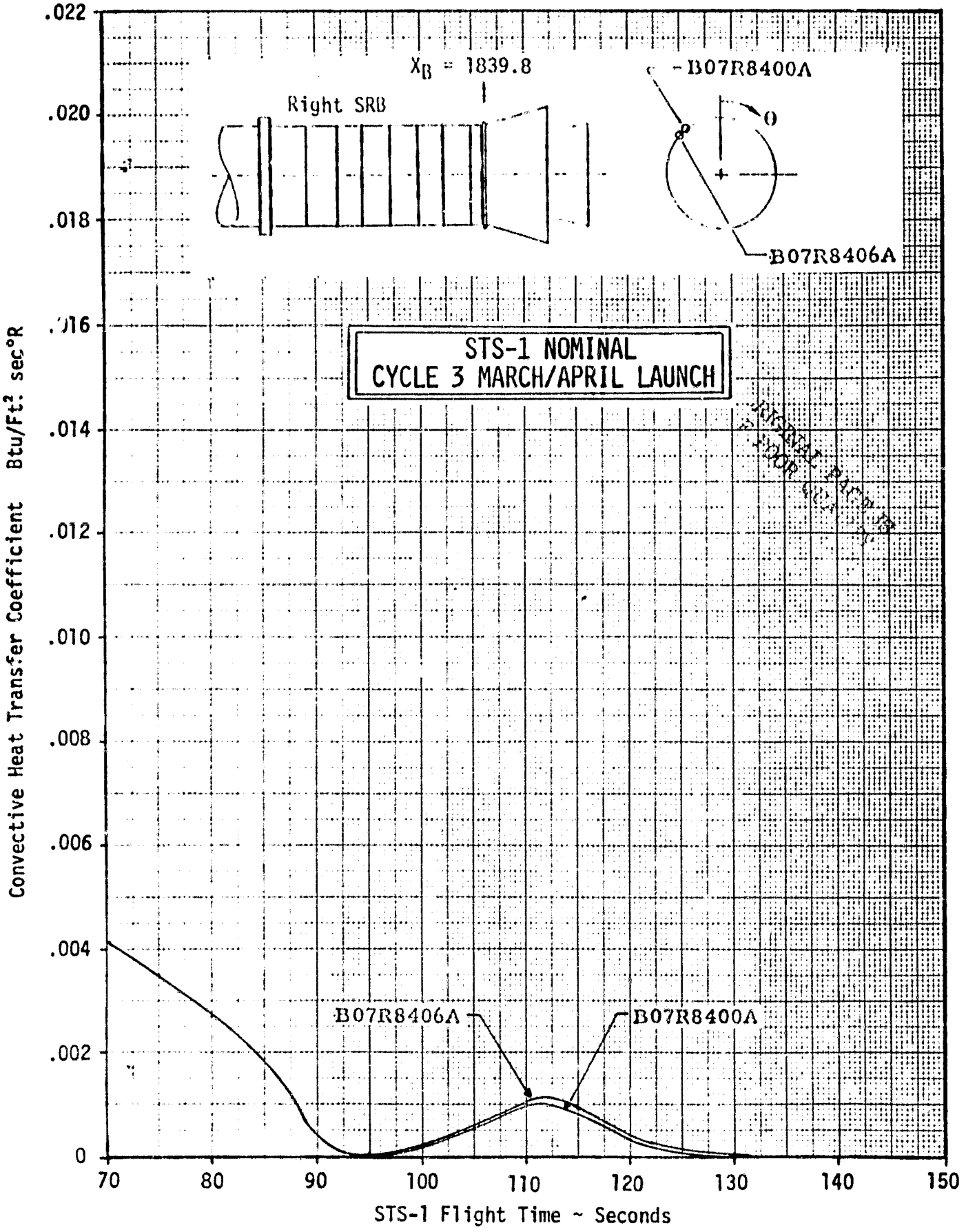

Figure 37 . STS-1 First Stage Convective Base Heating Environment - Right SRB

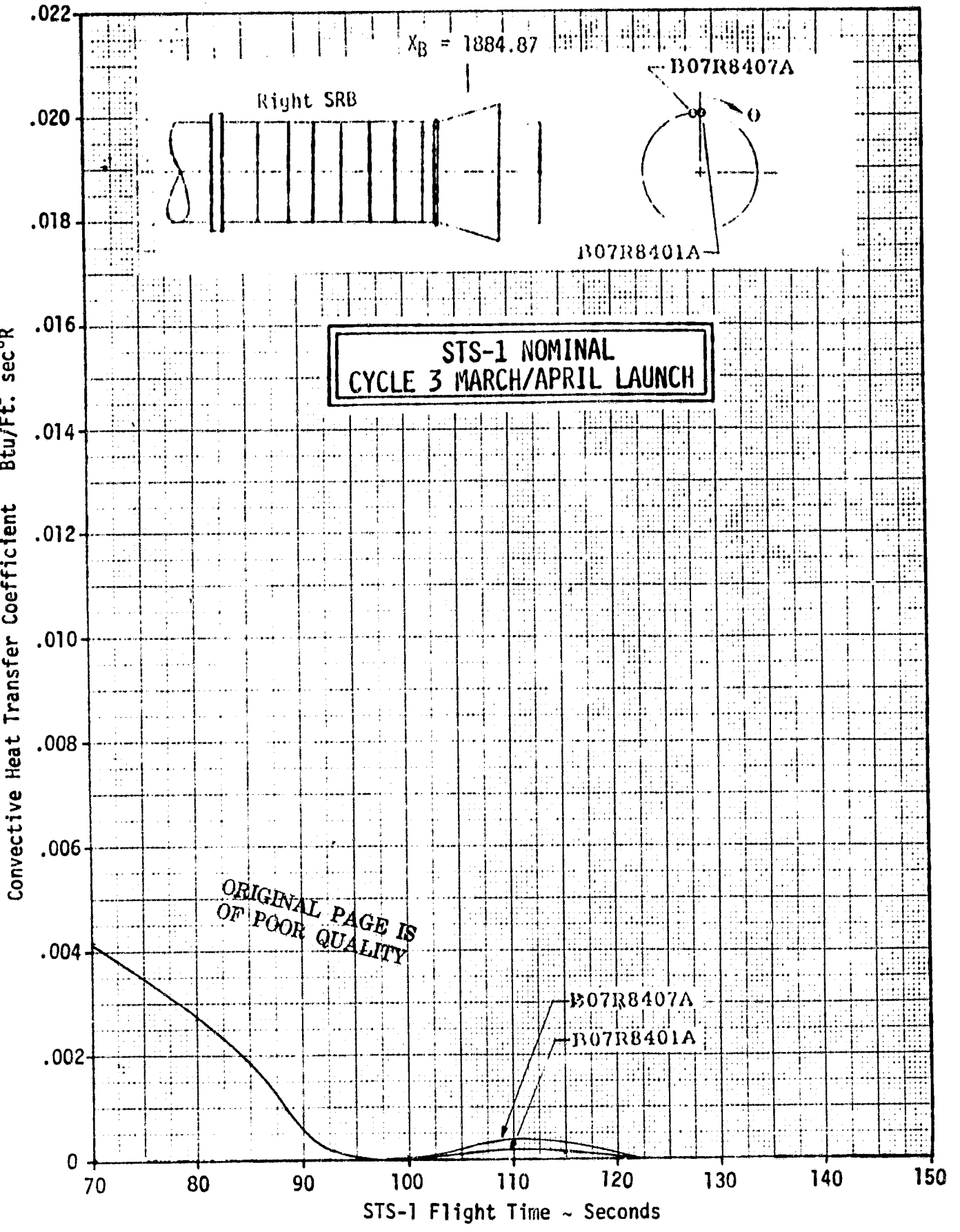

Figure 38. STS-1 First Stage Convective Base Heating Environment - Right SRB

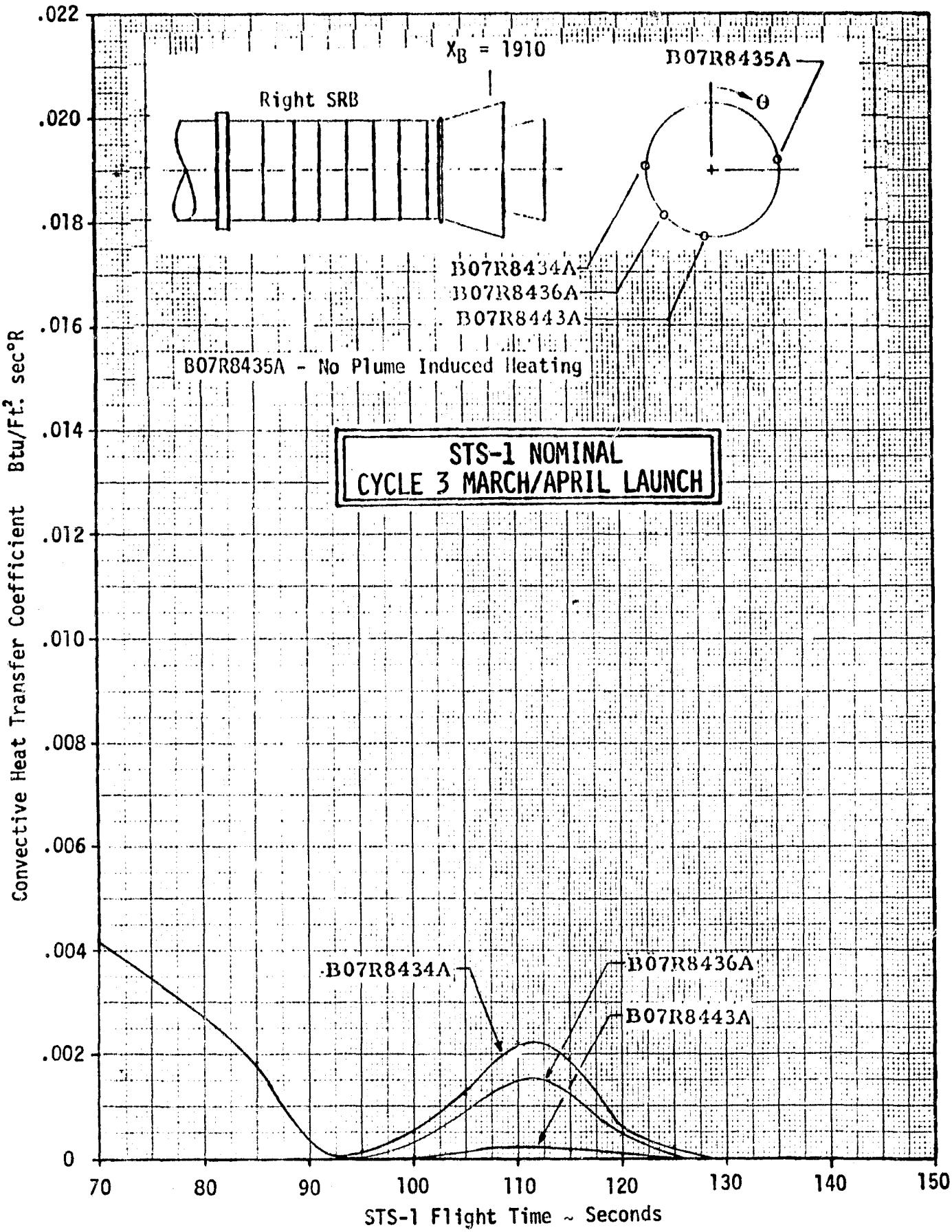

Figure 39. STS-1 First Stage Convective Base Heating Environment - Right SRB

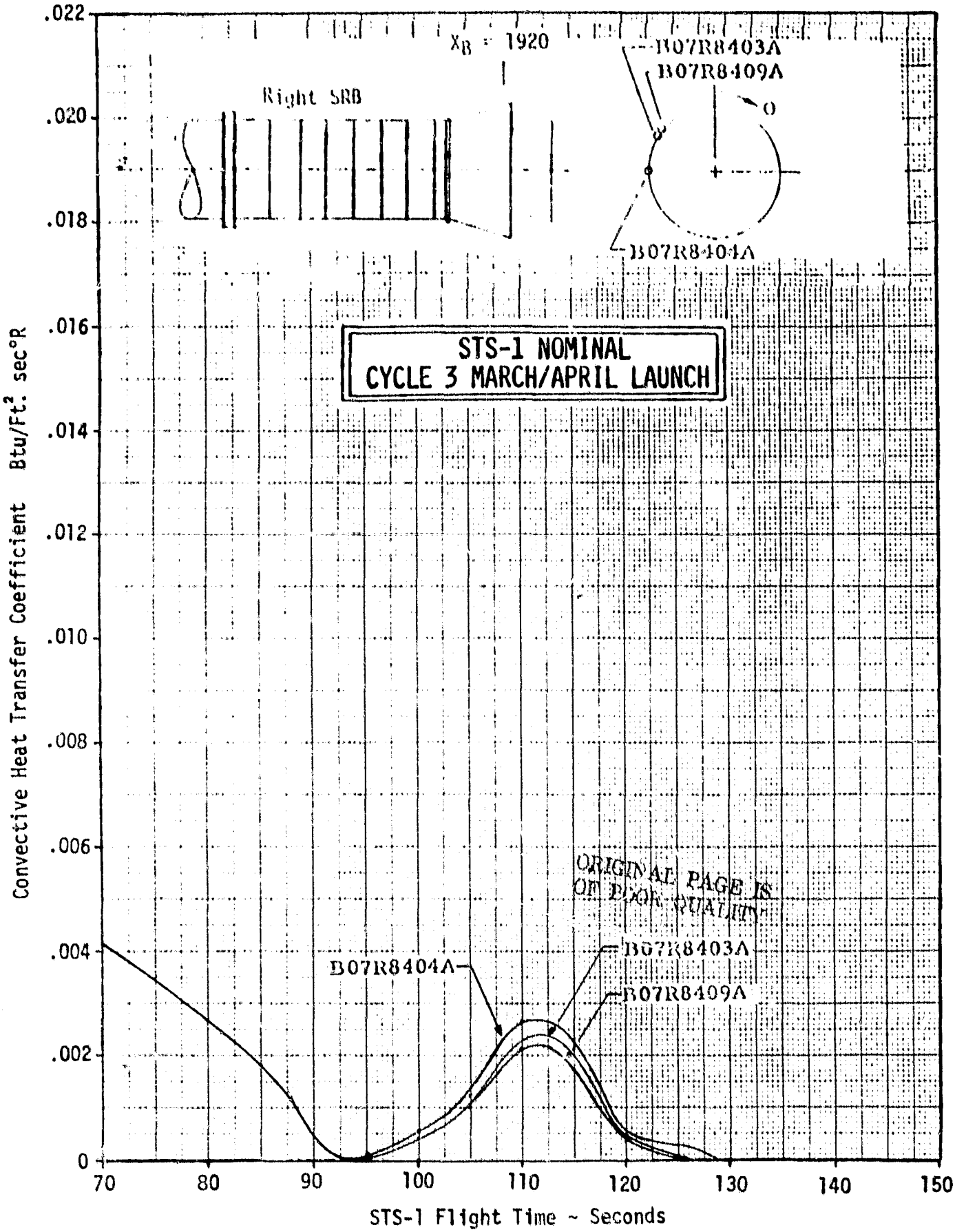

Figure 40. STS-1 First Stage Convective Base Heating Environment - Right SRB

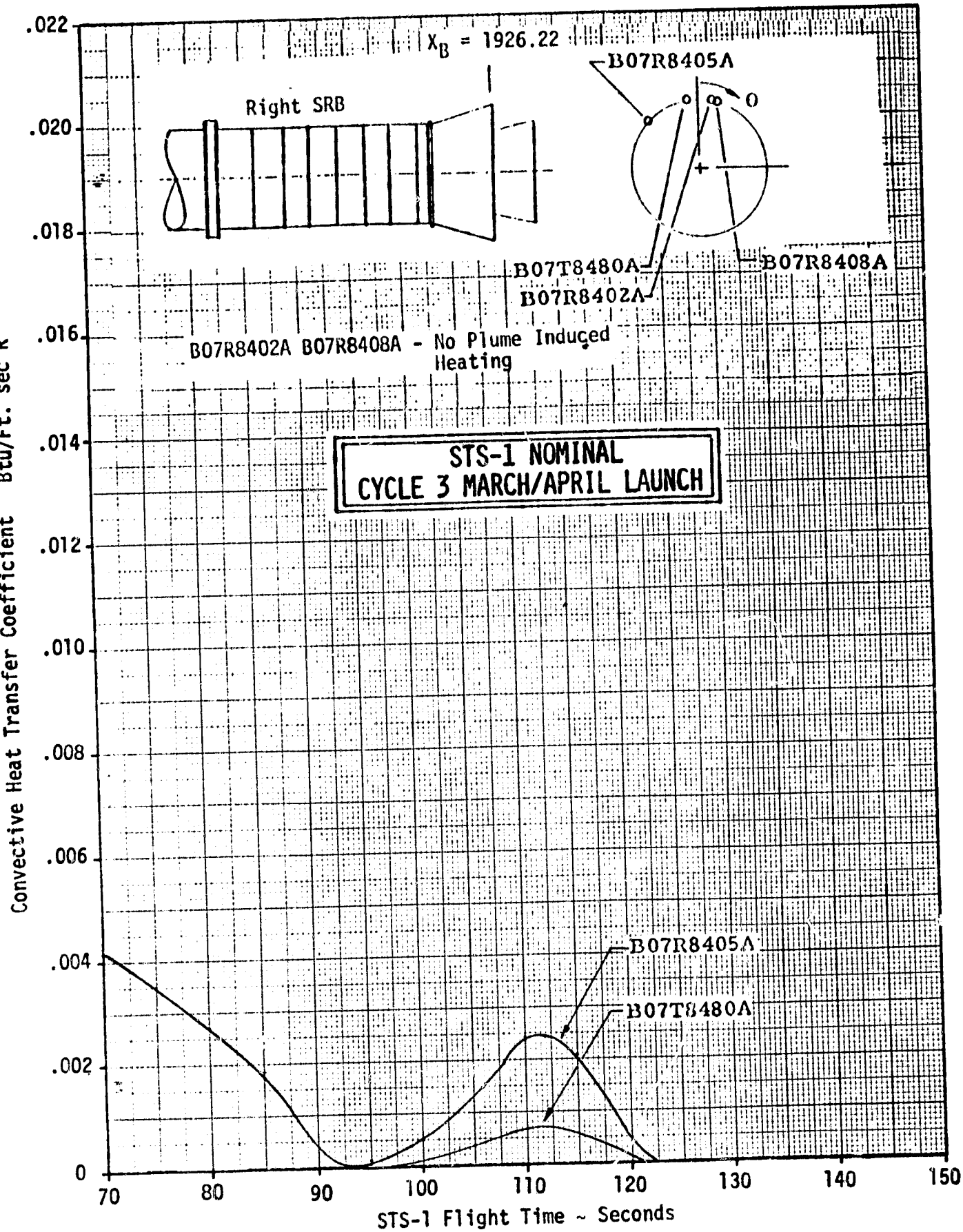

Figure 41. STS-1 First Stage Convective Base Heating Environment - Right SRB

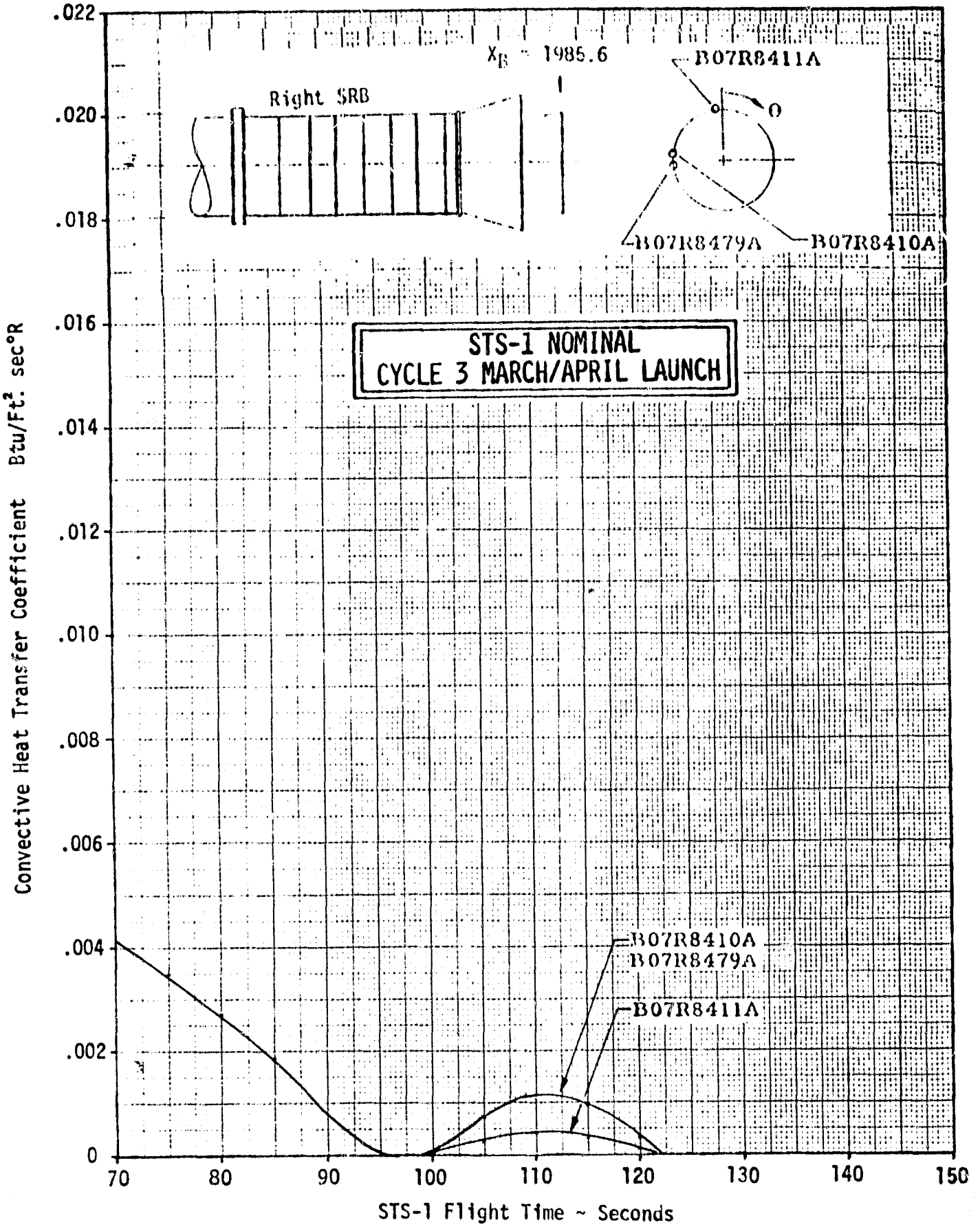

Figure 42. STS-1 First Stage Convective Base Heating Environment - Right SRB

STS-1 NOMINAL

SECOND STAGE CONVECTIVE BASE HEATING ENVIRONMENT

TO DFI LOCATIONS AND SELECTED DESIGN BODY POINTS

STS-1 NOMINAL

ORBITER INSTRUMENTATION LOCATIONS

INSTRUMENT	BODY POINT	HEAT TRANSFER COEFFICIENT X 1000, BTU/FT²SEC°R						
		FLIGHT TIME, SECONDS						
		131.4	200	300	400	453.7	496	512.8
HEAT SHIELD								
V07T9533-34	963	1.70	1.70	1.70	1.70	1.70	1.30	1.20
9535-36	925	0.27	0.26	0.25	0.28	0.36	0.43	0.45
9537-38	905	1.02	1.00	0.98	1.04	0.95	0.78	0.80
9539-43	909	0.11	0.11	0.11	0.11	0.11	0.09	0.08
9544-48		0.28	0.27	0.27	0.28	0.30	0.26	0.24
9549-53	925	0.27	0.26	0.25	0.28	0.36	0.43	0.45
9554-55		0.75	0.67	0.65	0.79	0.80	0.68	0.72
9556-60	905	1.02	1.00	0.98	1.04	0.95	0.78	0.80
9561-65	941	2.04	2.04	2.06	2.06	1.68	0.91	0.84
9566-70	945	1.93	2.01	2.04	1.91	1.40	0.96	0.73
9571-75	962	1.21	1.10	1.07	1.24	1.44	1.62	1.58
9576-77	923	0.42	0.39	0.39	0.44	0.53	0.59	0.63
BODY FLAP								
V07T9511-16	233	3.48	2.66	2.66	2.66	2.66	2.11	1.90
9517-18	241	2.71	2.65	2.62	2.72	2.89	2.49	2.32
OMS-RCS POD								
V07T9200-04		0.74	0.73	0.73	0.74	0.74	0.60	0.54
9205-09	787	2.06	2.01	2.00	2.08	2.27	2.24	2.15
9210-11	782	0.53	0.59	0.61	0.52	0.40	0.24	0.21
9212-16	773	0.68	0.68	0.67	0.68	0.54	0.31	0.26
9217-18	7765	0.51	0.56	0.58	0.50	0.38	0.23	0.19

STS-1 NOMINAL

ADDITIONAL ORBITER BODY POINTS

BODY POINT	HEAT TRANSFER COEFFICIENT X 1000, BTU/FT^{2}SEC$^\circ$R						
	FLIGHT TIME, SECONDS						
	131.4	200	300	400	453.7	496	512.8
HEAT SHIELD							
914	0.45	0.45	0.45	0.45	0.44	0.34	0.29
960	0.92	0.95	0.96	0.92	0.87	0.59	0.48
EMHS							
984	2.12	2.20	2.23	2.08	2.10	1.55	1.25
989	2.47	2.60	2.65	2.43	2.09	1.35	1.18
BODY FLAP							
236	0.36	0.38	0.40	0.41	0.43	0.38	0.30
239	0.14	0.14	0.14	0.14	0.14	0.11	0.10
OMS BASE							
784	0.14	0.14	0.15	0.12	0.09	0.08	0.07
778, 7700, 7705	0.10	0.10	0.10	0.10	0.10	0.08	0.07
RCS POD							
823, 828, 831, 884	0.87	0.72	0.67	0.92	1.05	0.47	0.32
853	0.48	0.45	0.42	0.49	0.73	0.42	0.34
861	0.60	0.65	0.67	0.57	0.38	0.22	0.25
RCS NOZZLE							
9861	0.87	0.72	0.67	0.92	1.05	0.47	0.32
-Z VERNIER							
7751	0.10	0.10	0.10	0.10	0.10	0.08	0.07

STS-1 NOMINAL

SSME INSTRUMENTATION LOCATIONS

INSTRUMENT	BODY POINT	HEAT TRANSFER COEFFICIENT X 1000, BTU/FT²SEC°R						
		FLIGHT TIME, SECONDS						
		131.4	200	300	400	453.7	496	512.8
SSME NO. 1								
E41R9117,19	7188	1.66	1.66	1.70	1.81	1.88	1.55	1.42
9120,22	7486	1.06	1.06	1.13	1.34	1.55	1.73	1.66
9124,26		0.38	0.39	0.41	0.45	0.51	0.52	0.50
9125		0.45	0.46	0.48	0.53	0.61	0.62	0.59
9135,37,39	7481	11.79	11.72	11.72	11.87	12.02	9.78	8.91
9140,41,42	7581	17.30	17.77	17.92	17.31	16.63	12.36	10.80
SSME NO. 2								
E41R9217,19	7248	0.66	0.61	0.59	0.67	0.80	0.68	0.61
9220,22	7748	1.07	0.98	0.96	1.09	1.30	1.11	0.99
9224,26	7848	0.49	0.45	0.45	0.50	0.60	0.51	0.46
9237,39	7741	1.68	1.62	1.59	1.69	2.03	2.44	2.80
9240,42	7841	0.82	0.79	0.78	0.82	0.99	1.19	1.36

STS-1 NOMINAL

ADDITIONAL SSME BODY POINTS

BODY POINT	HEAT TRANSFER COEFFICIENT X 1000, BTU/FT²SEC°R						
	FLIGHT TIME, SECONDS						
	131.4	200	300	400	453.7	496	512.8
SSME NO. 1							
7467	0.76	0.76	0.76	0.82	0.96	0.98	0.93
7567	0.46	0.46	0.46	0.50	0.58	0.59	0.57
7585	3.76	3.76	3.76	3.76	3.76	2.98	2.68
7491	1.47	1.47	1.47	1.14	1.05	0.75	0.59
7591,7561	0.92	0.92	0.92	0.72	0.66	0.47	0.37
7195	0.62	0.62	0.62	0.62	0.62	0.49	0.44
SSME NO. 2							
7281,7881	0.15	0.15	0.15	0.15	0.15	0.12	0.11
7781	0.27	0.27	0.27	0.27	0.27	0.22	0.19